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DEFECTS IN CENTRAL-STATION SERVICE.

The elimination of weak spots in central-station service is one of the most important problems associated with the sale of electrical energy on a considerable scale. Unless the supply of current is continuous upon the consumer's demand and unless the voltage regulation is close enough to enable highly sensitive lamp filaments to be used on all parts of the distributing system, the efforts of the best new-business department count for comparatively little. Loss of revenue and the establishment of severe competition are bound to appear sooner or later; the good will of the public rapidly shrinks into undisguised hostility, and finally the prosperity of the organization as a whole is likely to be threatened.

Troubles of the above kind are particularly prone to occur on the smaller central-station systems, which of necessity cannot often maintain the engineering organization capable of dealing in an expert way with the load distribution and the most effective methods of securing proper regulation. In a recent instance a small manufacturing community was aroused almost to the extent of attempting to establish a municipal plant, as a result of poor regulation on the circuits of the local lighting company. In this case the chief difficulty was high voltage, the potential running at from 120 to 125 volts on the secondary circuits nominally designed for 115-volt operation. The natural result was that scores of lamps went to a premature death, one establishment losing about seventy-five tungsten units of an expensive make in a short time. Disturbing fluctuations were common upon the system, and in a little while isolated plants began to go in. The service was handled by the electrical department of a country gas company, and at last accounts it appeared clear that nothing short of a careful engineering investigation of the entire system of distribution, combined with the installation of improved automatic regulating apparatus at the generating station will save the day. One of the greatest causes for dissatisfaction was that the bills rendered by the company were unusually high as a result of the excess voltage applied at meter terminals. Ordinarily the most common complaint in similar communities is that the voltage tends to run too low, or that it surges above and below the normal sufficiently to cause flickering. The occurrence of abnormal potentials on a

steam-driven central-station system is not in itself a problem of anything like the difficulty which surrounds similar troubles on long transmission lines and their secondary networks, but the above instance shows how close a relation exists between the regulation maintained and the attitude of the public.

Service defects must be attacked systematically in order to secure lasting improvement. The number and size of prime movers operated at different hours, the extent to which the governors control the speed of the engines or turbines; the degree of regularity with which the steam pressure is maintained, the relation of motor to lighting loads, and the extent to which loads upon individual feeders fluctuate and become re-distributed must all be looked after. In modern plants hand regulation is largely passing away, except where extensive changes in the voltage are manually imposed as the load increases or subsides. There is more room for the use of automatic recording voltmeters at temporary points of installation on the system. Such records are not necessary continuously, perhaps, but they throw no little light upon the service which the consumer is getting, particularly as new installations are connected and as new applications and times of use of current appear in different localities. Sooner or later the small central station operating combined lighting and power loads upon a common set of busbars must seriously consider the expense of installing automatic busbar or feeder-regulating apparatus, if there is to be any force to the argument that central-station service is more uniform and reliable than that rendered by isolated plants. The cost of good regulation sometimes looks large to the little company, but we believe that the consumer as a rule stands ready to pay for it, preferring to meet the expense fairly and squarely than to pay less for an inferior quality of service which both annoys him and shortens the life of his lighting equipment. From the station point of view, also, it is better to run the productive machinery in the station at relatively high load-factors on a single set of busbars than to attempt to segregate the output on individual machines which must perforce be operated at poor efficiency on account of underloading. Most important of all, however, is the giving of the best possible service for the price charged, fitting the latter to the system conditions with sufficient skill to cover the small fixed and operating expenses pertaining to automatic regulating equipment.

LIMITED FRANCHISE KILLED BY MASSACHUSETTS COMMISSION.

In a recently published decision admitting the Connecticut River Transmission Company to distribute electric power to large consumers in the town of Clinton, the Board of Gas and Electric Light Commissioners of Massachusetts has cancelled a limited-franchise provision made by the local authorities in granting the company a location, and emphasized the point that the public control of the electric-service situation would be much weakened by departing from the usual indeterminate franchise under Commission supervision. The local board of selectmen had imposed a 28-year limit upon the company. The decision of the Commission carries forward its well known policy of permitting large power companies selling electricity on a wholesale basis to enter territory in which local lighting companies are serving smaller power consumers, the former being restricted as to the connected load and consumption characteristics which may be taken as the basis of contracts. As in the cases formerly decided at Fitchburg and Worcester, the company is permitted to sell energy only to consumers of 800-horsepower rating or over, the municipality itself and the local electric lighting company being exempted. In this way the benefits of cheap hydroelectric power will be shared by all users of electricity in the community, and the results already obtained in the two communities above named are certain to be duplicated at Clinton.

CENTRAL-STATION SERVICE IN AGRICULTURAL COMMUNITIES.

Although the recent discussions of the use of electricity in farming are interesting and will doubtless not prove ineffective, it appears that certain important features of the situation have not been given due consideration. As to the utility of electricity on the farm, people at all well informed in matters electrical are already fully convinced. But the farmer, on the other hand, all allegations to the contrary notwithstanding, is very cautious about investing considerable sums of money in new and unfamiliar appliances; he usually has to be shown that the investment is going to prove profitable, and hitherto, even in many of the most prosperous agricultural sections, there has been but little general and determined effort to convince him of the advantages of electricity in agricultural processes. Moreover, it is a fact that central-station conditions in some of the largest and most prosperous agricultural sections of the country are very largely unfavorable to the introduction of electricity on the farm. And it may be added in this connection that these same conditions are likewise a serious handicap to profitable returns from the operation of the central station itself.

The cost of transmission lines built solely to supply farms with power is usually so great compared with the amount of power for which a market may thus be found as to prohibit the building of such lines altogether. Where these lines can be used to connect small towns and villages to the central station, however, the selling of electric power to the farmers along the way may often be made a very attractive proposition both to the consumer and the central station as well. But unfortunately the practice of supplying more than one town from a single generating plant has been confined largely to hydroelectric plants and to a relatively small number of the central stations in the larger commer-

cial centers. So in sections remote from hydroelectric stations and large towns, each small town generally undertakes to build its own central station, either through municipal enterprise or otherwise, or else to get along without the benefits of electric service. The plants are nearly always built solely with a view to supplying local needs, and in their management the original policy usually has to be adhered to regardless of all considerations of actual loss or possible gain. In one of the richest of the agricultural states there are small municipal central stations in surprisingly large numbers, each engaged in what is generally a futile effort to realize reasonable returns by serving only the little town of which it is a part; while on the surrounding farms and in neighboring villages there is often the opportunity of obtaining loads which would make the central station an attractive investment. It is not probable that conditions will be greatly improved here, however, while the matter is left with the municipality.

As already suggested, in some of these communities a single large central station for serving a number of small towns and villages and the intervening farms could probably be operated in a highly successful manner.

HIGHER ENGINEERING.

In an address to a body of engineering students at one of our leading universities, the speaker said that college-trained engineers of to-day may be divided into two classes, those who design and construct engineering structures as well as is possible according to existing standard practice, rules and customs, and those who endeavor to improve upon former methods and to develop new departures. Both classes are very necessary, or if there is any difference in importance, the former is the more essential, besides being by far the larger one. The duty of the one is to study existing practice carefully and thoroughly so that his work will be the best that can be done with existing knowledge. The duty of the other is to go more deeply into the subjects and find out whether existing practice is really the best, and whether it can be improved upon by new departures, sometimes perhaps of a revolutionary character. They may be likened respectively to the farmer who tills his soil in the best possible way known for the regulation crops, and the explorer or scientifically trained agriculturist who endeavors to find new and better fertilizers or better species of plants to grow. The former class, he remarked, may be said to keep the world moving, the latter to make it move faster. Or put in other terms, the former, although doing good work, is working in a rut, while the latter tries to climb out of the rut to see whether there is any better ground to work in elsewhere. A rut has been defined as "a grave, only it's longer." On the other hand it is the rut in a grooved rail that keeps the train on the track.

Both classes have existed for a long time, but until recently the one has been somewhat sneeringly referred to as a class of theorists, or wild inventors, and their ideas have been looked upon as visionary, impractical and useless. In the earlier days this was not entirely without justification owing often to the lack of appreciation which the so-called theorist had of the requirements of successful practice, and owing to the prominence of the uneducated inventors of the perpetual-motion class. In later times, however, the plodding, patient, ceaseless work of the searchers for new truths, often done with a purely altruistic spirit, has become recognized and appreciated more and more. This change of attitude has been due in large part to the fact that many of the studies of the scientists have turned out to be of great commercial value, as is evidenced for instance in the transmission of intelligence by means of waves of ether, known better as wireless telegraphy; also to the fact that the public at large, including the capitalists, is becoming better educated and is beginning to have more respect for higher intelligence; on the other hand the so-called scientific man today has a better realization of the requirements of successful practice. The electrical engineer has gotten the steam engineer out of his rut, resulting in very great improvements in engines; the scientific study of the velocity of the particles of steam has led to the useful steam turbine; the scientific study of the rare earths by the chemist has led to a more efficient gas lighting which in turn has urged the electrical engineer to study his lamp more scientifically, resulting in the tungsten lamp. The great value of the higher class of scientific research has in fact now been so fully recognized that some of the larger companies have found it profitable to maintain regular research laboratories, in some of which a very high class of scientific work is done. The so-called "scientific management" which is meeting with increased favor by the more progressive, when not overdone, is another instance showing how the more highly developed scientific training can be applied to business management.

This change has led to what might now be called "higher engineering," that is, that branch of engineering in which the higher education of the engineer, physicist or student is applied to the development of new departures from standard practice; to progress as distinguished from mere maintenance. The evidence of this can be seen everywhere, and it appears to be greatly disturbing the self-satisfied business men who had settled down comfortably to routine practice based on the standards of the past; and who now find themselves rudely awakened to recognize that they have been asleep in a rut and that they must now do some hustling to keep up with those who are awake and more progressive. The first attempt of those thus disturbed was to try to stifle the more progressive by coercion and greater power of control, but the strongest walls must ultimately break down under a persistently increasing and accumulating force, and the most effective of such forces is the power of the higher intellect.

Schedule for 1912 Lamp Lighting.

The ELECTRICAL REVIEW AND WESTERN ELECTRICIAN has prepared for the year 1912 a schedule for lighting street lamps which shows in tabular form the proper time for lighting and extinguishing lamps on the moonlight schedule and the all-night schedule. The total number of hours of lighting each month is given for these two schedules and also for Frund's system and the moonlight-midnight system. By the latter is meant following the moonlight schedule until midnight, after which no lamps are operated on any night.

This schedule is in the form of a sheet of convenient size, which forms an insert in a small booklet containing instructions and other information. The schedule sheet may be removed for posting on the wall for easy reference.

One copy of this lighting schedule will be sent free of charge to any subscriber requesting one. The price to others and for additional copies will be, as heretofore, ten cents.

A Committee on Rubber Analysis.

It is a well recognized fact that the art of analyzing rubber compounds has not reached the state of perfection which the commercial importance of rubber products seems to warrant. Various chemists have developed methods of analysis possessing more or less merit, but at the present time these methods cannot be relied upon to give concordant results. Users of rubber-insulated wire are particularly interested in the analysis of rubber compounds owing to the recent practice of inserting chemical clauses in specifications. The manufacturers are equally interested because in the present state of the art, they are likely to have insulation refused by their customers, not because it is defective, but because some unforeseen method of chemical analysis indicates that the specifications have not been complied with. Chemists are interested not only in the scientific aspects of the problem, but also in its commercial aspects, because the chemical specification for rubber, with all it implies in its relation to chemists, will drop out of use unless the chemists are able to stand back of it with an analysis that cannot be controverted. Realizing these conditions, E. B. Katte, chief engineer of electric traction of the New York Central Railroad, invited a number of prominent manufacturers, consumers and chemists, to a conference at which the subject of rubber specifications could be discussed and steps taken to secure the desired uniformity in rubber analysis.

The conference was held on December 7, the attendance including representatives of the United States Army, the New York Central Railroad, the Pennsylvania Railroad, the General Electric Company, the Standard Underground Cable Company, the Simplex Electrical Company, the Hazard Manufacturing Company, the American Chemical Society, and several chemists who have made a specialty of rubber analysis. Samuel Reber was elected chairman, after a discussion of the various aspects of the problem, the following committee was nominated to determine a standard procedure in the analysis of rubber compounds: H. B. Rodman, Pennsylvania Railroad, Altoona, Pa.; C. R. Boggs, Simplex Electrical Company, Cambridge, Mass.; W. B. Gieser, New York Central Railroad, Albany, N. Y.; P. Poetschke, The Lederle Laboratories, New York; James P. Millwood, Brooklyn, N. Y.; Wallace Clark, General Electric Company, Schenectady, N. Y.; W. A. Del Mar, New York Central Railroad, New York.

The work of the committee will be largely in the nature of laboratory tests and comparison of results by correspondence and periodic meetings. Suggestions and communications will be received by the secretary, W. A. Del Mar, 335 Madison Avenue, New York, N. Y.

French Cable Company Lowers Rates.

The French Telegraph Cable Company has announced that it would put into immediate effect a flat cable rate of five cents a word for deferred press dispatches between New York and London and London and New York, thus meeting the five-cent rate for similar cablegrams already operative with the Commercial Cable Company and the Western Union Company.

A flat rate of five cents for deferred press dispatches between New York and Paris and Paris and New York is contemplated by the French Company and will be made operative as soon as the assent of the French administration had been obtained.

Electrical Exports for October.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its monthly summary of imports and exports of the United States for the month of October. From these statistics the following data relative to the exports of electrical products are obtained.

The figures for October show some improvement over the corresponding ones of a year ago, both in appliance and machinery shipments. The machinery exports were not quite as heavy as in the preceding months, however. The comparative monthly data are as follows:

Month.	Electrical Appliances.	Electrical Machinery.	Total.
October, 1911	$851,650	$583,000	$1,434,650
September, 1911	841,769	658,831	1,500,600
October, 1910	780,233	514,184	1,294,417

A summary of the principal countries to which electrical products were sent in October, together with the value of these shipments, is given below:

Countries.	Electrical Appliances.	Electrical Machinery.
United Kingdom	$ 66,995	$ 63,958
Canada	289,220	141,702
Mexico	53,959	48,035
Cuba	35,502	30,513
Brazil	183,332	70,292
Japan	32,006	43,633

Canadians Discuss Conduit Work.

G. M. Gest, of New York City, delivered a very interesting address before the Canadian Society of Civil Engineers on December 14. The lecture dealt with underground conduit work, and was illustrated by moving pictures showing the operations in connection with the work in various cities of the United States, England and Mexico. The chair at the meeting was occupied by H. M. Vaughn, chairman of the Committee on Papers.

Better Light for Subway Cars.

The Interborough Rapid Transit Company, of New York City, is to make considerable improvements in connection with lighting its subway cars. The Interborough has installed storage batteries in more than 300 of its new cars, and according to Frank Hedley, vice-president of the system, the number will be increased. At some future time it is probable that a system of twenty five-volt lamps will be employed, although this will not be done at present.

Iron Mountain Line Adopts Telephone.

The block system and train dispatching by telephone has been adopted by the Iron Mountain Railroad and equipment of its lines has been completed.

Thomas Eugene Mitten.

The distinction of having first installed pay-as-you-enter cars in America, of having in a few years converted the extensive system of the Chicago City Railway Company from a chaotic condition to one of order and profit, and of having done this in such a manner as to please the stockholders, employees and the public, has been achieved by Thomas E. Mitten, who recently tendered his resignation as president of that company. The truth of his assumption that a regard for the welfare of employees and for public opinion are necessary for successful operation of a public utility, is borne out by the present prosperous condition of the Chicago City Railway Company.

Mr. Mitten was born in Brighton, England, in 1865, and came to this country with his parents when but fifteen years of age. At nineteen his railway career began, when, coming from a farm at Newton, Ind., he became telegraph operator and joint agent for the Chicago & Eastern Illinois Railroad at the Wyndham, Ind., station. He later became local agent at Attica, Ind. After that time he served in minor positions with several roads, becoming in 1890 general superintendent of the Denver, Lakewood & Golden Railroad.

In 1893, when the electric railway was but in its infancy and its operating and executive problems had to be worked out, Mr. Mitten left the old steam lines and entered this new field, becoming assistant superintendent of the street-railway system of Milwaukee. Soon afterward he was made general superintendent. Milwaukee was at that time in the throes of a railroad strike, and his talents for organization and arbitration were so well applied that an equitable arrangement was soon made and the system placed on a profitable basis.

Just prior to the Pan-American Exposition at Buffalo, he became general superintendent of the International Railway Company, which operates extensive lines in Buffalo and in the Niagara region. During the Exposition the claims on the resources of the railway were extremely heavy. Crowds were flocking in from all over the country, attracted by both the Falls and the Exposition and putting an abnormally heavy summer load on the system. Here again Mr. Mitten's capacity for organization manifested itself to such advantage that at the close of the season he was made general manager of the system.

His successful management had attracted such attention that in 1905 he was made vice-president of the Chicago City Railway Company, and changed his field of activity to that city. Very shortly afterward he was made president of the company. Although attracted by the Chicago opportunity, he was so strongly urged to retain connections with the Buffalo company that he has since acted as its vice-president and has directed its business policy.

THOMAS E. MITTEN,
Notable Manager of Traction Properties.

Throughout his connections with steam and electric railways his ideals of fair treatment of the public and the company employees have been maintained. His success has been evident; his promotion has been rapid. Although every inducement was made to retain Mr. Mitten in the service of the Chicago City Railway Company, he believed that, as the work of rehabilitation was over in Chicago, his work was needed in other fields. His resignation from the Chicago City Railway Company becomes effective on December 31, after which time he will give all his attention to organization and rehabilitation work on the railway systems of Buffalo and Philadelphia. He has been made managing director of the International Traction Company of Buffalo, and chairman of the Executive Committee of the Philadelphia Rapid Transit Company.

Electrical Development Abroad.

Frederick Sargent, of Chicago, who has been investigating manufacturing conditions abroad, reported on his return that, while the improvements over our methods were small, there were a number of interesting developments.

"The latest thing in electrical work in England," he stated, "is that being done at Newcastle-on-Tyne, where a company's system extends for forty or fifty miles, and picks up a number of industrial centers. They take the waste heat from iron furnaces, and employ it for the generation of electric power. A favorite scheme is to take the coke gas that is thrown off in the preparation of by-products and use that for making electricity. Of course, the company buys the waste heat and gas, and there you have a wonderful illustration of the development of the conservation idea."

Aside from electrical developments he remarked that one of the most interesting things he noted was a 2,000-horsepower oil engine of a type being made at Winterthur, Switzerland.

Brooklyn Engineers Meet.

The fifteenth annual meeting and dinner of the Brooklyn Engineers' Club was held recently at the Hamilton Club, Brooklyn. Officers elected were: president, William T. Donnelly; secretary, Joseph Strachan; treasurer, James W. Nelson.

Meeting of the Jovian Luncheon Club.

A most enthusiastic meeting of the recently organized New York Jovian Luncheon Club was held Wednesday, December 13, at Kalil's Restaurant, 18 Park Row.

The attendance numbered 137, which against 105 at the previous meeting and about 25 at the first meeting, certainly shows rapid progress.

C. A. S. Howlett, of the General Electric Company, was the speaker of the day. After complimenting the chairman of the meeting, F. E. Watts, of the Sunbeam Incandescent Lamp Company, on his enthusiasm and industry in connection with the organization, Mr. Howlett spoke very forcibly on the necessity of such an organization having some work of a practical nature to do in order to bind it more firmly together.

He used as an illustration the organization of the first Luncheon Club in Chicago, showing that while the first meetings were of benefit from the co-operative "come-together" spirit, which was engendered among its members, the fact that there was nothing practical to do lead in a short time to the dissolution of the organization.

He compared this first organization with the organization of the Electric Club, of Chicago, of the present day. The fact that it had been in existence now for several years and that it was successful, and had a constantly growing, enthusiastic membership of practically all the live wide-awake electrical men in the city of Chicago, was due entirely to the fact that the Electric Club, of Chicago, was doing things—doing things of a practical and definite nature. At each one of their meetings, which are held weekly, there is always one speaker who has something to say which is of interest to the electrical men of Chicago—something which the Chicago men should know about, should discuss among themselves and work together on, either for or against. When it is remembered that the present organization is composed of exactly the same men who were members of the organization which failed for lack of purpose, Mr. Howlett's illustration was a very forcible one.

A Membership Committee, a Press Committee and a Speakers Committee have been appointed and from the personnel of these various committees and from the enthusiasm of all the members of the present body, it looks as though New York City was to be numbered among those in the rapidly growing list of successful electrical organizations in the United States.

The next meeting is to be held on December 27 at Kalil's Restaurant and at this meeting there is to be arranged a big Jovian rejuvenation. While the organization is composed, at present, of Jovians, the idea is not to limit the Luncheon Club to only those who are Jovians, but to invite to each luncheon any and all who are interested in any way in the development of the electrical industry.

Peoria Electric Show.

The Peoria Show Association will hold its first annual electrical show in Peoria, Ill., January 22 to 27, 1912. It will be open each day from 10 a. m. to 10:30 p. m. The admission fee to the public will be twenty-five cents.

The show is meeting with the hearty co-operation of electrical manufacturers and supply men and the outlook is encouraging for a very successful exhibition. Much of the floor space has already been disposed of. There will be feature entertainments of a high character and the show is being widely advertised throughout the Mississippi Valley.

PEORIA COLISEUM.

The show will be held in the Peoria Coliseum, which has a ground floor space of 15,364 square feet. It is shown in the accompanying illustration. The secretary of the Association is Leroy A. Mills.

A New Element of Platinum Group.

Announcement has been made by A. G. French of the discovery of a new metal of the platinum group, which he has named "canadium." The mine from which the new element was taken is in British Columbia. The metal occurs native, can be melted with the blowpipe, but cannot be oxidized.

New York Railway Distributes Christmas Fund.

The distribution of a Christmas fund amounting to $40,000 was announced by the directors of the Interborough Rapid Transit Company. This fund will be given at the rate of $5 in gold to each employee receiving $110 a month or less who has been on the company's pay roll since December 31, 1910.

Reorganization of Allis-Chalmers Company.

In anticipation of the company's financial reorganization the common shareholders of the Allis-Chalmers Company have formed a committee for the protection of their interests.

The committee's chairman is A. J. Hemphill, president of the Guaranty Trust Company. Other members of the committee are: Frederick Strauss, of J. & W. Seligman & Company; Albert H. Wiggin, president of the Chase National Bank, and J. Horace Harding, of C. D. Barney & Company.

The common stockholders will be asked to deposit their shares with the Guarantee Trust Company.

The report of the committee recently organized to consider plans for the rehabilitation of the Allis-Chalmers Company is expected shortly.

The bondholders' committee, organized some days ago, is advertising for holders of bonds to deposit them with the Central Trust Company, New York City.

Minnesota Electrical Association Convention and Show.

The fifth annual convention of the Minnesota Electrical Association will be held in Minneapolis, Minn., March 20, 21 and 22. As previously announced, the third annual Minneapolis Electric Show will be held the week of March 16-23 so that the delegates to the convention will have an opportunity to inspect the various exhibits.

Also, under the auspices of the Minnesota Branch, the American Institute of Electrical Engineers will hold a meeting on March 19 and 20. The Minnesota Electrical Contractors will also hold their semi-annual convention in Minneapolis during the week of the show.

A number of special features have been arranged for the show.

The Wilmette Pumping Station.

Unique Design of an Electric Pumping Plant.

An electric pumping plant of considerable interest was placed in operation this year at Wilmette, Ill., by the Sanitary District of Chicago. Although the important engineering works undertaken by the Sanitary District within the last score of years are familiar to most readers of technical journals, a brief summary is desirable in order to understand the purposes of the station to be described in this article.

FIG. 1.—VIEW OF THE WILMETTE STATION AND BRIDGE FROM THE SOUTHWEST.

The water supply of the city of Chicago and of all the suburban cities and villages directly north of it, is obtained from Lake Michigan. Formerly a large part of the city's sewage flowed into the lake, and as the result of this contamination frequent epidemics swept over the city. The Sanitary District of Chicago was therefore organized to provide for all the sewage that had flowed into the lake. At a cost of about $35,000,000 a thirty-mile canal was dug from the South Branch of the Chicago River to between Lockport and Joliet, Ill. The flow of this river was reversed from the lake into this canal, and discharged into the DesPlaines River to find its way ultimately into the Mississippi River. At the discharge end of the Drainage Canal a hydroelectric station was built to utilize the thirty-five-foot fall at this point; from this station electrical energy is transmitted to Chicago and used principally for municipal purposes in and near the city.

Four intercepting sewers were built along the lake shore by the City to take the flow from the sewers that formerly had emptied directly into the lake. At Thirty-ninth Street a station was built to pump the discharge from the two South Side intercepting sewers, as well as a large quantity of lake water for dilution, into a twenty-foot sewer under Thirty-ninth Street that drains into a fork of the South Branch of the river. At Lawrence Avenue a similar station pumps the diluted sewage from the two North Side intercepting sewers into the North Branch of the river. These two pumping stations were built by the City and have now been turned over to the Sanitary District, which already has converted part of their steam-driven equipment to electric pumping.

Directly north of Chicago are the city of Evanston and the villages of Wilmette, Kenilworth, Winnetka, Glencoe, etc., all within the area of the Sanitary District of Chicago. To take care of the sewage from these communities, the North Shore Channel was dug within the last two years. It runs from the southern part of Wilmette southwesterly through Evanston and then southerly through the northern part of Chicago to a connection with the North Branch of the Chicago River near Kedzie Avenue. Its width is about 40 feet at the base, 80 feet at the water line, and 120 feet at its banks. Into it will be discharged a number of intercepting sewers still to be built along the lake shore; a number of Evanston sewers drain into it already.

In order to provide a positive flow in this channel from the lake into the river, it was necessary to install a pumping station. The most suitable location for it was found to be near the lake entrance of the channel. About 400 feet from the lake the channel is crossed by Sheridan Road, which is a fine boulevard connecting all of the North Shore suburbs with Chicago. As a monumental bridge for this crossing was evidently desirable, it was considered expedient to combine both the bridge and pumping station in one structure.

As shown in Figs. 1 and 2, this was very successfully accomplished. The entire design is unique. The bridge has exceptionally graceful lines. It has a total length of about 240 feet; the roadway is 46 feet wide and there is an eight-foot sidewalk on either side. The bridge and station were built of structural steel and are faced with Bedford stone. The pumping station oc-

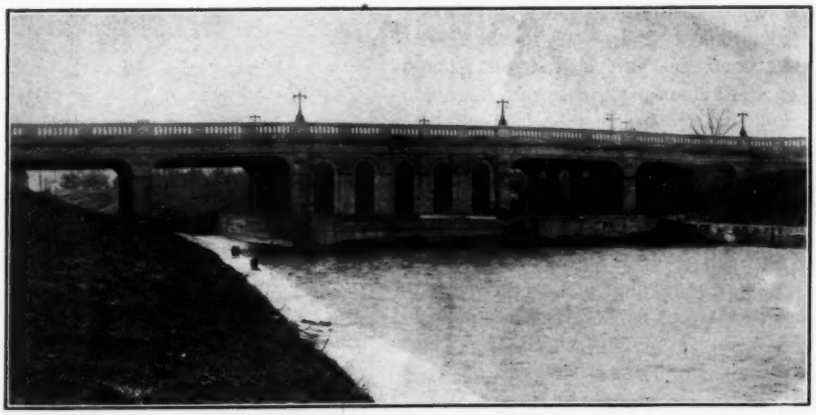

FIG. 2.—VIEW FROM THE NORTHEAST, SHOWING LOCK AT THE LEFT.

cupies the space directly beneath the center span. From the bridge nothing can be seen of the station except a portion of the lock and part of the inlet cribway. On the northwest side of the station is a roadway for the delivery of machinery and supplies. On the southeast side is the lock, which has dimensions of 22 by 120 feet. This lock can be used by dredges and scows in future dredging operations, and is also intended for the use of motor boats and other small pleasure craft that it is expected will make use of the North Shore Channel.

The station consists of two main rooms neatly lined with white glazed brick. In the southwesterly portion is the motor room with an area of 29 by 54 feet, and a height of 36 feet. In the northeasterly portion is the transformer room with similar dimensions, except as to height. Directly beneath the transformer room are located the four tunnels in which the large pumps are installed.

The main pumping equipment consists of four screw pumps. A number of views of the runners of these pumps were given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of August 27, 1910, page 435. The diameter of the runner is nine feet, and the normal speed seventy-five revolutions per minute. The pumping capacity of each of the screw pumps is 15,000 cubic feet per minute, or a total of about 10,000,000 gallons per twenty-four hour day for the entire station. The pumps operate against a head of one to two feet, depending upon the lake level. The gates in the main tunnels on the discharge end are opened by means of chains that can be seen in Figs. 3 and 5. These gates are of the flap type.

A general view of the motor room is shown in Fig. 3. The principal equipment in this room is the group of four induction motors that are geared to the pump shafts. A closer view of one of these units is shown in Fig. 4. The motors are three-phase, 440-volt, 60-cycle, 150-horsepower induction motors with wound rotors. They were supplied by the General Electric Company. The motors are arranged for variable-speed control; their normal speed is 514 revolutions per minute. The motors are controlled from the front of the operating switchboard. As shown in Figs. 3 and 7, there are four control pedestals near the edge of the platform. In each case the body of the controller itself is mounted horizontally underneath the switchboard gallery, the shaft in the pedestal being connected with the controller shaft by means of beveled gears. Alongside the controllers and underneath the switchboard are the iron-grid secondary resistances. Each of the four motors is connected to its pump shaft through a single-reduction spur gear and flexible coupling. The gear ratio is 514 to 75. A specially designed thrust bearing is provided to relieve the motor of the end thrust on the shaft.

A fifteen-horsepower induction motor direct-connected to a centrifugal pump is arranged along the center of the southwest side of the motor room, see Fig. 5. This unit is used for draining each of the pump tunnels, also a sump underneath the motor room. It can also be used for converting the lock into a dry-dock, and in the summer it is available for sprinkling the lawns about the bridge. This set, as well as the four large screw pumps, was provided by Allis-Chalmers Company, Milwaukee.

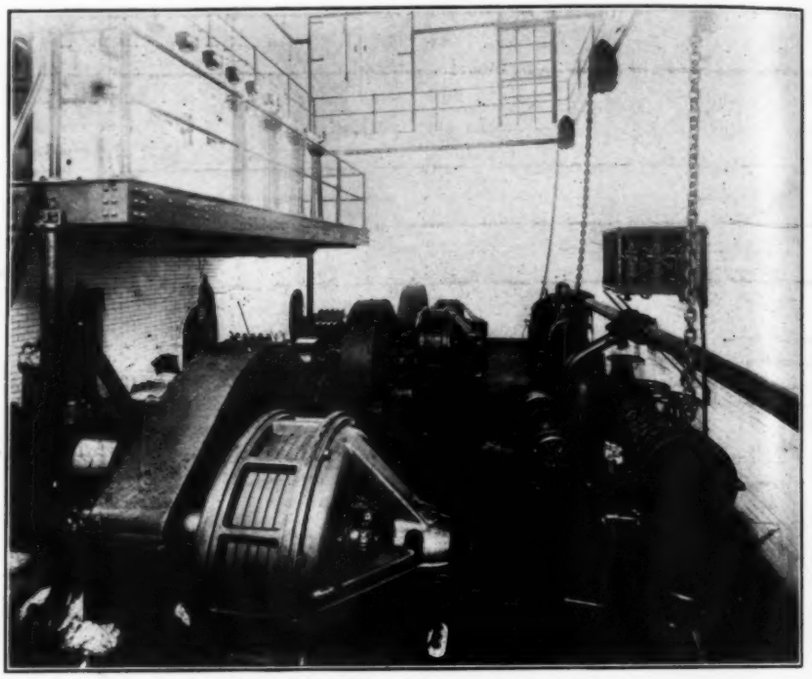

FIG. 3.—GENERAL VIEW OF THE MOTOR ROOM

The electrical supply for the station is obtained over two independent 12,000-volt supply circuits, that are carried from the District's terminal station at Thirty-first Street and Western Avenue partly in underground conduit and partly on a steel tower line. One of these steel towers may be seen at the right in Fig. 2. From this last tower the circuits are carried in underground cables to the inner wall of the trans-

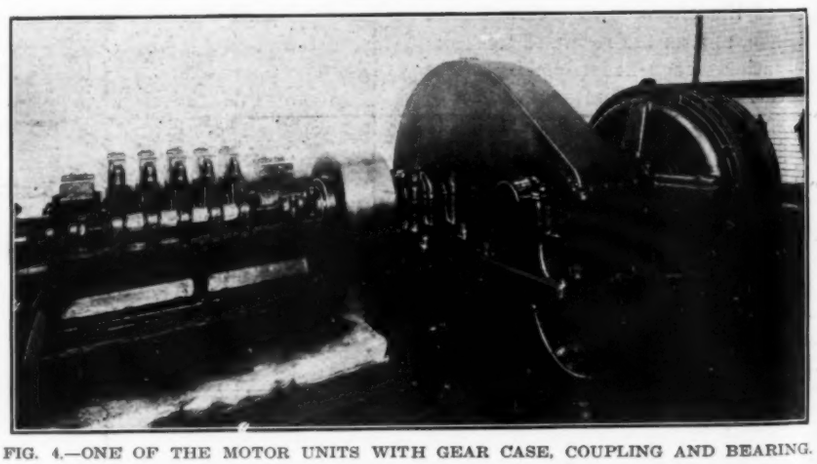

FIG. 4.—ONE OF THE MOTOR UNITS WITH GEAR CASE, COUPLING AND BEARING.

former room. Here a set of tie switches is provided for connecting them in parallel. There is also a set of disconnecting switches for each of the circuits between them and the oil switches through which they pass to the high-tension buses.

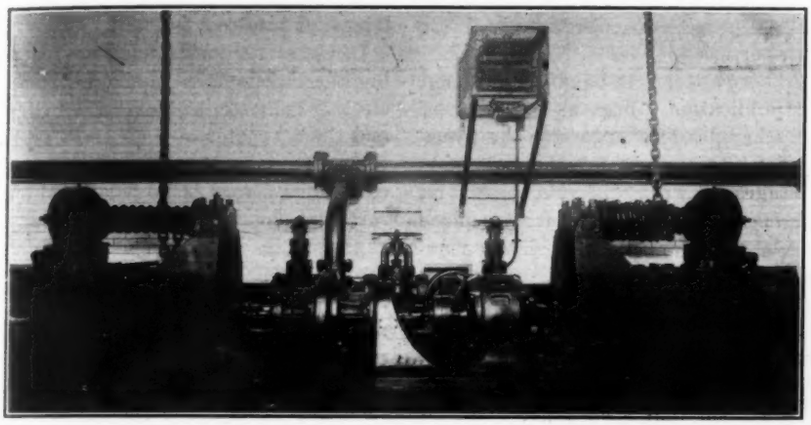

FIG. 5.—MOTOR-DRIVEN CENTRIFUGAL SUMP PUMP AND HOISTING DEVICES FOR DISCHARGE GATES.

A view of the transformer room is shown in Fig. 6. There are provided two banks each of three 150-kilowatt, single-phase transformers, stepping down from 12,000 to 440 volts. The transformers are self-cooled, oil-insulated and of the standard type supplied by the Pittsburgh Transformer Company. Tubular busbars are used for both high-tension and low-tension buses. There is also a bank of three thirty-kilowatt, single-phase transformers, supplied by the same firm, that are used for stepping down from 440 to 110 volts for the lighting circuits and small motors that operate the lock and a motor-generator set. The latter is installed at the opposite end of the room. It consists of a Wagner single-phase motor driving a Roth Brothers thirty-two-volt generator for charging a small storage battery of twelve cells. This battery is used, in case of failure of the power, to operate the high-tension oil switches and also to provide current for some twenty-four-volt lamps in the transformer room and over the switchboard.

FIG. 6.—GENERAL VIEW IN TRANSFORMER ROOM.

The switchboard, a view of which is shown in Fig. 7, consists of eight panels. The first two of these control the two main feeders on the low-tension side. The third to the sixth panels, inclusive, control the four large pump motors. The seventh panel is for the sump motor, and the last panel at the right controls the lighting and other 110-volt circuits. On each of these panels is an oil switch and circuit-breaker furnished by the Hartman Circuit Breaker Company. Each panel also has a Wagner horizontal edgewise wattmeter. The first and last panels are provided with similar voltmeters, and the second panel also has a Westinghouse graphic totalizing wattmeter. In the wall back of the switchboard are four cabinets for the lighting circuits. In one of these is a pair of double-pole double-throw switches for the circuits over the switchboard and in the transformer room. This enables the twenty-four-volt lamps on these circuits to be thrown either on the storage battery already referred to or onto the secondary of a small transformer reducing from 110 to 24 volts. As the station uses no fuel whatever, it had been intended to install about twenty electric heaters along the base of the walls in the motor room. These have not been necessary, however, and have not yet been put in.

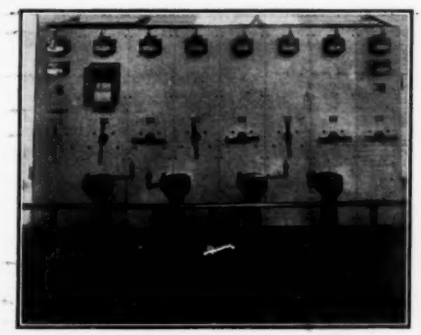

FIG. 7.—MAIN SWITCHBOARD AND MOTOR-CONTROL PEDESTALS.

The Wilmette pumping station was designed by the engineering department of the Sanitary District, under the direction of G. M. Wisner, chief engineer, C. R. Dart, bridge engineer, and E. B. Ellicott, electrical engineer.

Tests of Electric Purification of Sewage.

The city of Pasadena, Cal., is considering the possibility of electrically purifying its sewage. The installation of this type at Santa Monica, Cal., which is claimed to be completely successful, will be investigated first and then thorough tests will be made.

Report of Interstate Commerce Commission.

The twenty-fifth annual report of the Interstate Commerce Commission, which was sent to Congress this week, is by far the best exposition of the methods of procedure before that body and of the work that it has already done, is doing, and expects to do in the future, that has been given to the public. The work of the Commission is carried on with greater simplicity and with greater efficiency than that of almost any other department of the government's activities, and that work has been multiplied many times since the passage of the Mann-Elkins Act of 1910, which added to the power of the Commission not only the consideration of the long-and-short-haul provisions, but the right to suspend new tariffs and proposed changes in existing tariffs until such time as it has had opportunity to investigate as to their propriety and reasonableness.

Section I of the act, as amended June 18, 1910, provides that the Act shall apply to telephone, telegraph and cable companies, whether wire or wireless. In this connection the Commission says:

"Numerous questions were asked informally as to the instances in which and the extent to which the provisions of the act applied to such companies. In December, 1910, the Commission heard arguments upon certain of such questions, and in March, 1911, expressed its views as to what telegraph and telephone companies are subject to the provisions of the act and the nature and character of the service which would render a telegraph or telephone company subject thereto. It was there said that such companies are subject to the provisions of Sections I, III, XV and XX of the Act insofar as the terms thereof appropriately apply to such companies.

"Section VI of the act requires each carrier to print, file, and post schedules of its rates, fares, and charges for transportation between different points on its own route and points on the route of any other carrier by railroad, by pipe-line, or by water, when a through route and joint rate have been established, and provides that the schedules printed as aforesaid by any such common carrier shall plainly state the places between which property and passengers will be carried and shall also state separately all terminal charges which in any wise change, affect, or determine any part of the aggregate charges or the value of the service rendered to the shipper, passenger or consignee. It requires that such schedules shall be printed and copies thereof posted in every depot, station, or office of such carrier where passengers or freight, respectively, are received for transportation.

"There appears to be no requirement for publication, filing, and posting of the schedules of charges for the transmission of telegraph, telephone or cable messages between different places on the same route or line or from a place on one route or line to a place on another route or line.

"The foundation of efficient regulation, both as to the reasonableness of rates and undue discrimination, rests in lawfully established charges, and it would seem that such lawfully established charges should be contained in officially filed schedules which would be binding upon the telephone, telegraph, and cable companies and those for whom such companies perform service.

"The penalties and prohibitions of Section I of the Act of February 19, 1903, commonly called the Elkins Act, are founded upon lawfully published and filed tariffs and would seem not to apply in the absence of such lawfully published and filed tariffs.

"It is thought, therefore, that telephone, telegraph and cable companies should be required to publish, file and post tariffs of schedules for interstate business. There are thousands of small independent telephone companies whose business is intrastate except in occasional instances where their lines are used in connection with the lines of other companies for interstate messages. The Bell Telephone System has, we are informed, more than five million central and pay telephone stations. It would probably be unreasonable and unnecessary to require that full schedules of charges should be posted in every telephone booth or in every branch telegraph office. All rates for interstate business should, however, be filed with the Commission and be so posted as to afford interested users or patrons opportunity to ascertain the lawful charge for a given service.

"We recommend, therefore, that Section VI of the Act be amended so as to require telephone, telegraph, and cable companies to publish, file, and post schedules of their interstate charges in such manner and to such extent as may be required by the Commission.

"In this connection attention is called to the apparent necessity for changes in the Elkins Act in order to make it clearly applicable to telephone, telegraph, and cable companies."

In view of the circumstances attending the development and operation of electric railways of the United States and the character of their traffic, it has been recognized that under present conditions a very large portion of such railways should not be considered as engaging in interstate commerce, although, as noted in the last preceding report, the tendency on the part of many to engage in the interstate transportation of passengers, of freight, and of express matter has continued, and there are examples of the development of extensive traffic on numerous electric lines which seem to be ready to enter the field once solely occupied by the steam roads.

The work of the Division of Statistics relating to electric railways has been of a rather preliminary nature, looking in part toward the establishment of a full and satisfactory list of the companies that are clearly engaged in interstate commerce and subject to the jurisdiction of the Interstate Commerce Commission.

The year ended last June was the fourth one for which detailed annual reports were required from electric railway companies, and it should be noted that the relative number of companies reporting has increased with each successive year. Because of the fact that the number of companies reporting is only a small fraction of the entire number in the United States, and their financial importance even less in proportion, it was not deemed advisable, at this time, to compile from their reports any figures for publication, although such reports are tested and analyzed in order to determine their reliability.

It was deemed worthy of mention in the report that nearly all the State Commissions that have jurisdiction over electric railways have made use of forms for report substantially the same as those used by the Interstate Commerce Commission, thus contributing in large measure to a uniformity in requirements which it can readily be seen is very desirable.

MEASUREMENT OF ELECTRICAL ENERGY BY RECORDING WATT-HOUR METERS.—I.

ROTATING-FIELD INDUCTION METERS.

BY JOSEPH B. BAKER.

Construction.—The great bulk of the alternating-current meters of the present day are of the induction type, employing a disk or cup-shaped rotating element, constituting both the driving armature and the damping disk.

The induction meter is designed to record the energy in alternating-current circuits, and is in principle a split-phase induction motor, driving a magnetic-friction load which is developed by the drag of damping magnets on the disk. The phase relation necessary to give the "rotating magnetic field" is provided by the use of two sets of field coils upon iron cores, so wound as to give a large phase angle between these fields and therefore between the two alternating magnetic fluxes produced by them. These fields are the potential or shunt field, which is wound with a large number of turns of fine wire, giving a highly inductive winding in which the current lags behind the potential; and the series field, which is wound with comparatively few turns of coarse wire, giving a nearly non-inductive winding in which the current is almost in phase with the potential.

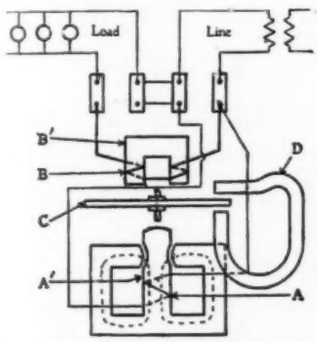

FIG. 1.—CONSTRUCTION AND CONNECTIONS OF WESTINGHOUSE SINGLE-PHASE INDUCTION METER.

With the rotating system consisting only of a disk, and with the commutator eliminated, the shaft may be, and is, very short and the rotating system is light compared to that of the commutator meter, and its running friction is very low and constant. Hence the rotating system of the induction meter is at an immense advantage compared to that of the commutator meter.

General Principle of Operation.—The following explanation of the principle of operation of the induction meter applies particularly to the Westinghouse induction-type integrating watt-hour meter, but will afford general guidance in the study of all commercial induction meters.

The rotation of the disk is caused by the reaction of the two field fluxes upon Foucault or eddy currents induced in the disk by these fluxes. It is well known that when a closed conductor is intercepted by an alternating magnetic flux, eddy currents are induced in the conductor. It is also true that when a current is passed through a conductor which lies in a magnetic field, a force is produced which tends to drive the conductor out of the field. These actions go on in the induction meter, in which the disk, constituting the closed conductor, has eddy currents induced in it by the two field fluxes. By the construction, the resultant eddy currents and fluxes are in phase, and the reaction between them exerts a torque upon the disk which maintains it in rotation, against the drag of the damping magnets, at a speed approximately proportional to the load.

Operation on Non-Inductive Circuits.—The operation of the induction meter on a non-inductive load will be clear from the following description, referring to the accompanying sketch of the construction and connections of a Westinghouse single-phase induction meter, Fig. 1, general interior views of the meter, Figs. 2 and 3, and diagram of the relation of the fields, by quarter-periods, throughout one complete cycle.

Referring to Fig. 1, a high-inductance winding *A* is placed on the middle limb of the laminated iron core *A'*, the wound core constituting the shunt field of the meter. The pair of coils *B*, wound on the two limbs of the laminated iron core *B'* and having low inductance, forms the series field. At *C*, midway between the shunt and series fields, is the disk armature, fixed to a vertical shaft which runs on a jewel step-bearing and actuates a register. The permanent magnet *D*, with its jaws or poles inclosing the edge of the disk as shown, is one of the two damping magnets with which each of the meters is equipped.

As already stated, the combination operates like an induction motor. The shunt-field coil is bridged across the mains, so that the alternating flux in its core is proportional to the *potential* impressed on the load circuit. The series-field coil is connected in series with the load, so that its alternating flux is proportional to the load *current*. The disk has eddy currents induced in it by these two fluxes, and the former flux, owing to the high inductance of the shunt field coils, lags very nearly ninety degrees behind the electromotive force. The combined effect of the shunt-field and series-field fluxes is the progressive shifting of the resultant flux known as a rotating field.

This production of a rotating field is made clearer by reference to the diagrams and to Table A. In Fig. 1 the series-field core *B'*, and the shunt-field core *A'*, are supported the one inverted above the other, and so separated that the disk armature runs with its edge inclosed between the two poles of the upper core and the middle pole of the lower one. The series-field winding makes a pair of poles of opposite polarity, for a given direction of current in this winding; and the shunt-field winding makes the two outside poles of its core of identical polarity, and a third pole, at the top of the middle leg of this core of the opposite polarity, for a given direction of current in the shunt-field winding. Further, since the mutual phase relations of the series-field and shunt-field windings is such that the magnetic condition of the three-pole shunt-field system lags one-quarter pe-

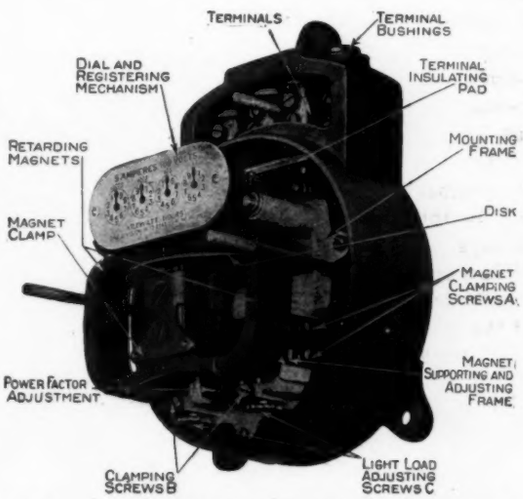

FIG. 2.—WESTINGHOUSE INDUCTION METER WITH COVER REMOVED.

riod behind the magnetic condition of the two-pole series-field system (as indicated in Fig. 4) the magnetic condition of each pole of the row of five poles, presented to the disk armature embraced between them, will be at any instant one-quarter period behind its next neighbor on the one side and one-quarter period ahead of its next neighbor on the other side. Thus the magnetic condition of the five poles at the start of the alternation, graphically represented in Fig. 4, is indicated by the top line of algebraic signs in Table I.

TABLE I.

	A	B	C	D	A_1
Start	+	0	−	0	+
Quarter Period	0	−	0	+	0
Half Period	−	0	+	0	−
Three-quarter Period	0	+	0	−	0
Finish	+	0	−	0	+

The condition at the end of the first quarter-period of the alternation is represented by the second line of this table, which indicates a virtual shifting of the resultant field constituted by the group of poles one-quarter period to the left; and so on through the entire alternation, only to be repeated for the next and the succeeding alternations. This virtual shifting of the resultant field is in effect a continuous flow of fluxes from left to right—a shifting or rotating field—which by its reaction on the currents induced in the edge of the disk armature inclosed by the group of poles drags the armature after it.

In other words, the combined effect of the series-field and shunt-field fluxes, separated as they are by one-quarter period, gives rise to an armature field which lags behind the resultant field of these coils; thereby creating a torque in the disk which is directly proportional to the power (assuming zero iron and copper losses). This torque causes rotation of the disk in the counter-clockwise direction; and this rotation is at a speed which is proportional to the power, for the reason that the damping magnets oppose the motion by a retarding force which varies directly as the speed of rotation (assuming zero friction).

Operation on Inductive Circuits.—The above explanation is based on the assumption that the current producing the shunt-field lags exactly ninety degrees behind that producing the series-field, the iron losses and the copper losses being zero. The drag on the disk by the shifting field will then be at a maximum (as indicated by Table I) when the load is of non-inductive character, such as a group of incandescent lamps; for with non-inductive load the current in the series-field coil will be in phase with the line voltage.

Assuming now that the circuit in which the meter is connected is purely inductive (has zero power-factor), the current in the series-field coil itself will lag ninety degrees behind the line voltage, and so will be in phase with the current in the shunt-field coil. In accordance with these altered conditions Table I must now be re-written as shown in Table II.

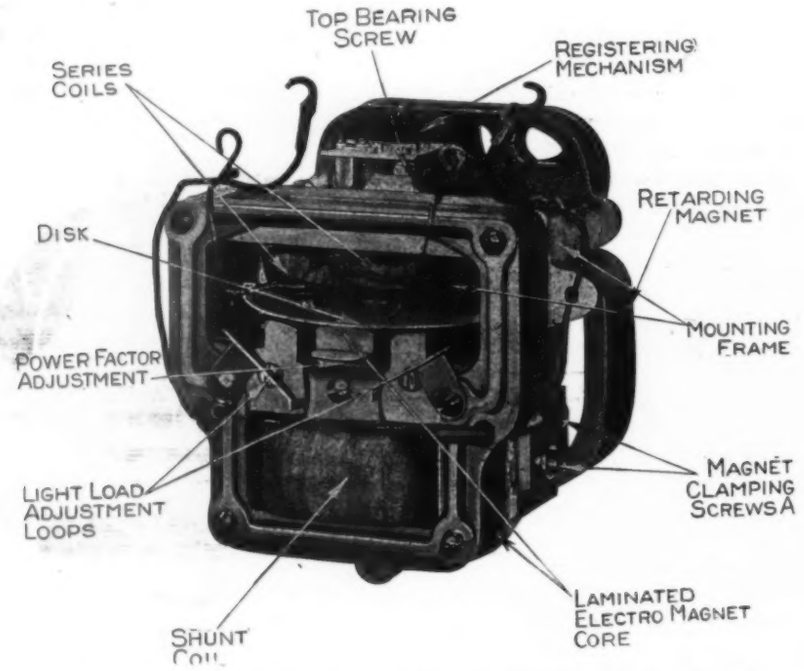

FIG. 3.—REAR INTERIOR VIEW OF WESTINGHOUSE INDUCTION METER.

TABLE II.

	A	B	C	D	A_1
Start	+	+	−	−	+
Quarter Period	0	0	0	0	0
Half Period	−	−	+	+	−
Three-quarter Period	0	0	0	0	0
Finish	+	+	−	−	+

Inspection of Table II shows that no progressive shifting of the resultant field occurs, and there is consequently no drag on the disk to cause rotation of same.

Therefore the meter will not register on a wattless load; it will record true power only.

Adjustments, Friction and Magnet Strength.—The adjustments that are applied to commercial induction meters consist in the shifting of the damping magnets for the full-load adjustment, and of auxiliary conductors with respect to the shunt field for friction compensation and for frequency and power-factor adjustment.

In this article only a few typical forms of commercial induction meters will be discussed, and the reader is referred to the trade literature issued by the several meter manufacturers for more extended descriptions, accounts of more recent forms of single-phase and polyphase service meters, and of test meters[1] and prepayment meters, diagrams of connections, etc. House-service forms only are referred to in this article.

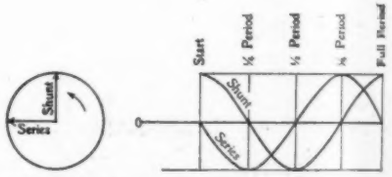

FIG. 4.—DIAGRAM SHOWING RELATION BETWEEN SHUNT AND SERIES FIELDS OF INDUCTION METER.

The general construction of the single-phase induction meters made by the Westinghouse Electric & Manufacturing Company is shown in Figs. 2 and 3.

The full-load adjustment[2] of the single-phase meter is obtained by shifting the damping magnets after loosening the clamping screws (see the general views of meter). Friction compensation

1 For a discussion of commercial test meters, the reader is referred to a serial article by the present writer entitled "The Test-Meter Method of Testing Service Meters," ELECTRICAL REVIEW, August 8 to September 19, 1908.

2 The adjustments of the Westinghouse Induction Meter are more fully described in the serial article by the present writer entitled "Details of Watt-hour Meter Manufacture," ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, August 14 to September 18, 1909.

is affected by changing the position of a pair of auxiliary conductors (closed loops) in the air gaps of the shunt field, towards or away from the shunt-field coil, thereby varying a slight auxiliary torque due to the potential circuit alone.

The name "high-torque" applied to the induction meters manufactured by the General Electric Company indicates the line of endeavor of that company to minimize the effect of bearing friction.

In the Thomson high-torque induction meter, type I, the potential and current coils are wound upon a laminated soft-iron core forming a magnetic circuit which is closed except for the air gap in which the disk moves, in order to obtain high torque with minimum losses, and are fastened to a removable frame which also carries the other parts of the meter, comprising register, damping magnets, and rotating system. This construction, giving a closed magnetic circuit, reduces the effect of stray fields.

The new type C Westinghouse induction meter, also, embodies the closed-magnetic-circuit design.[3] As in the commutator meter, the regis-

FIG. 5.—THOMSON HIGH-TORQUE INDUCTION METER, TYPE I.

ter reads directly in kilowatt-hours, and is removable without interfering with the adjustment of the worm and worm gear.

The compensation for variable friction (light-load adjustment) is obtained by an adjustable metal rectangle or "starting plate," supported on the meter frame just below the potential coil.

The type I meter, in common with all other induction meters, is not strictly interchangeable on all frequencies. Means are therefore provided by which

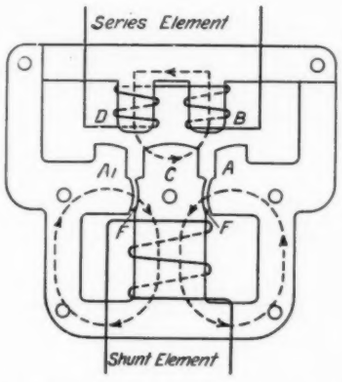

FIG. 6.—DIAGRAM OF SHUNT AND SERIES FIELDS OF TYPE C WESTINGHOUSE INDUCTION METER.

meters intended for use on circuits of higher frequency than sixty cycles (the standard lighting-circuit frequency) can readily be adjusted on sixty cycles without recalibration for operation on either inductive or non-inductive loads. This adjustment is made by changing two connections.

In order to prevent "creeping" two holes are punched at diametrically opposite points on the disk near its edge. The removal of the metal at these points increases the resistance to the flow of eddy currents in the disk when the latter is in a certain position relative to the field core. Any tendency of the disk to be rotated by the potential field alone is checked when one of the holes comes opposite a potential pole, and the effect is to prevent the disk from passing the said position, *i. e.*, from creeping more than half a revolution.

The meters manufactured by the Fort Wayne Electric Works are similar in general principle—that of the split-phase induction motor—to other induction meters, but present the following distinctive features. (Figs. 7, 8 and 9.)

A unique form of combined armature and damping disk is employed consisting of an inverted aluminum "cup" of light but rigid design, with vertical damping magnet or magnets, the jaws of which inclose the vertical wall of the cup. The use of this arrangement, instead of the more usual flat disk, permits a close approach of the magnet jaws to the wall of the cup—that is, a small clearance—and at the same time considerable up-and-down adjustment of the rotating system. The cup, which is pressed out of sheet aluminum, is fixed on a composite steel-and-brass shaft shouldered to receive the cup.

With regard to the use of a cup-shaped armature the makers of the Fort Wayne meters state, in the bulletin describing the high-torque type K meter: "Obtaining a high ratio (of torque to weight) solely by reducing the weight, produces an armature of weak mechanical construction, which, when subjected to the twisting strain produced by sudden heavy loads or short-circuits is so distorted as to prevent free movement of the rotating element. The cup armature combines unusual strength and minimum weight and effectually resists the distorting strains of sudden increases in load. The rotative force applied to the armature is sufficient to produce rapid acceleration to respond to sudden increase in load. The ratio between rotative force and weight of cup-shaped

FIG. 7.—FORT WAYNE SINGLE-PHASE INDUCTION METER.

rotating element is such as to give the best results on fluctuating loads and insure long jewel life."

In the Fort Wayne single-phase meter, the damping magnets are mounted vertically with their jaws inclosing the rim of the cup armature. The top bearing is a coil of phosphor-bronze wire contained in a brass stud; an arrangement which permits a certain freedom of movement, and is claimed to eliminate rattling. For other details of these meters, and for details of Columbia induction meters, the most recent bulletins of these makers should be perused.

The following discussion of the effects of amount and constancy of friction of

[3] Other improvements in this meter are a positive full-load adjustment, including an arrangement which is claimed to make it impossible to twist the magnets out of adjustment in tightening their clamping-screws, and a delicate micrometer-screw light-load adjustment. For all that the writer knows to the contrary, similar improvements are to be found in other forms of commercial induction meters; the constant improvements in meter design make it practically impossible to record the very latest forms of American meters, and the reader is referred to trade literature on the subject.

rotating element, and of strength and constant magnetization of damping magnets, is in order at this point, in connection wtih the friction compensation of watt-hour meters. The term "connected load" will mean the load—lamps, motors, or what not—which the meter is set to measure, and the "meter load" the expenditure of power in the meter itself.

In a theoretically perfect rotating watt-hour meter the registration, and therefore the speed, would obviously be exactly proportional to the connected load. Also the torque developed would be proportional to the connected load. It follows that the speed of a meter should be proportional to the torque. This can only be true when the meter load is proportional to the torque. If the meter load were of such character that it varied strictly with the speed, this ideal (meter load proportional to torque) would be reached; but the actual meter load consists not only of the "magnetic friction" between disk and damping magnets, which is exactly proportional to the speed, but also of mechanical friction, which not only is not proportional to the speed, but varies erratically. The endeavor of the meter manufacturer is, then, so to design his meter that the assigned meter load will consist of as much magnetic friction as possible, and as little mechanical friction (including windage) as possible. The magnetic friction can be made high, but the mechanical friction, although it may be reduced to a very low value, cannot be reduced to zero. Nevertheless, by such construction, a relatively large amount of the internal work will be done in the generation of Foucault currents, *i. e.*, in accordance with the law of the meter, and such a relatively small amount in the mechanical friction, that the unavoidable variation of the latter may not produce much inaccuracy. The tendency of design is therefore to provide as high a torque as may be obtained without unduly large copper or iron losses, and in conjunction therewith a good jewel bearing, a light and compact rotating element, turning at moderate speed, and a powerful damping-magnet system.

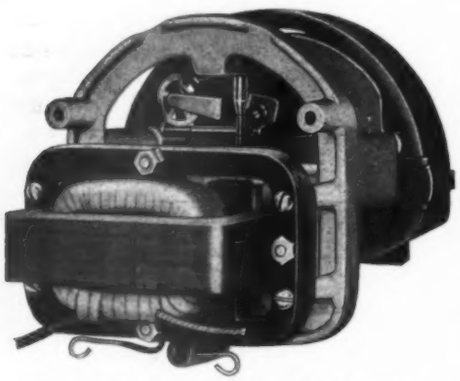

FIG. 8.—REAR INTERIOR VIEW OF FORT WAYNE INDUCTION METER.

But if the calibration of the meter is to be maintained constant in service, all these features must be carried out in the construction so that they will be permanent. The high torque will remain unchanged, as it resides solely in the design of the windings and rotating element; whereas the friction, for a given weight of rotating element, is governed by the condition of the jewel bearing, and the consistency of the damping effect is governed by the permanence of the magnet system. (As we have induction meters only under consideration, commutator friction does not enter in.) The high-grade construction of the "first drive" from meter shaft to register, and of the register itself, to secure minimum friction, are assumed. The friction in a good register is of little importance compared with jewel friction, on account of the slow average speed of the members of the dial train. A slight change in the magnet strength will cause a marked error in the meter, as the reaction between the Foucault currents, generated in a mass of metal moving through a magnetic field, is proportional to the square of the field strength.

The meter manufacturer's endeavor is therefore to provide a high torque while keeping the mechanical friction at constant minimum value (high ratio of torque to friction), and to provide magnets having constant, sufficiently high strength (permanent damping magnets). Good magnets are today available, but the combination of a high torque with the light rotating element essential to the attaining of low friction is a very live problem, the attempted solution of which by the several meter manufacturers has resulted in very diverse designs. In the old Stanley meter, the use of the "magnetic floatation" gave a very high ratio of torque to friction, by reducing the friction to a negligible quantity; but the makers of present-day commercial meters are confronted with the limitations of jewel step bearings. In attacking this problem, some companies, such as the Westinghouse Company, have sought to secure a good ratio by working in the direction of extraordinary lightness and low friction; others, such as the General Electric Company, by working in the direction of high torque, as already mentioned.

To a broad view, the claim of "high torque" on the one hand, and "light rotating element" on the other, are no more than commercial catchwords; the securing of a good ratio is the important thing. High torque can easily be obtained, either by using a thicker or higher-conductivity (and therefore heavier) disk, thus increasing the strength of the eddy currents induced in it, or by expending a considerable amount of energy in the operating windings of the meter; or by both of these constructions. High torque tends to minimize the effect of friction, and is a long step toward a perfect meter; but when obtaining it means excessive weight of rotating element, it may be of little or no advantage, or may even result in disadvantage because increasing the initial friction and the liability of erratic variation of friction under service conditions. Moreover a meter having an unduly heavy rotating element is not sufficiently responsive to fluctuations of load, and therefore will not integrate a rapidly fluctuating or intermittent load with as great accuracy as a meter

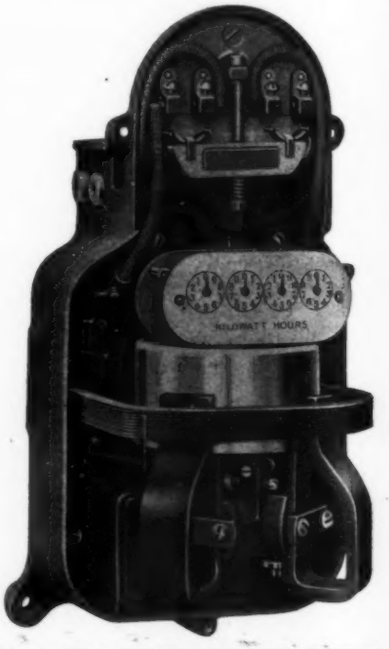

FIG. 9.—FORT WAYNE TYPE K-3 PREPAYMENT INDUCTION METER.
The prepayment switch is at top.

having a light rotating element. On the other hand, the weight of the rotating element may be made too low for mechanical strength. Increasing the meter losses is likewise objectionable; for although the excessive loss in a single meter would be of little account, the aggregate consumption of energy in the entire installation of meters on a central-station system—comparable to the aggregate magnetizing energy of an installation of low-efficiency transformers—would be large.

(To be continued.)

Measuring Electric Current in Absolute Units.

Under the title "A Determination of the International Ampere in Absolute Measure," E. B. Rosa, N. E. Dorsey and J. M. Miller have reported to the Washington Academy of Sciences their work at the Bureau of Standards.

The absolute unit of current in the electromagnetic system is defined in terms of the magnetic field which it produces. Hence we can measure current in absolute units by measuring the magnetic field due to the current, or by measuring the ratio between this field and some other field which is measurable, as, for example, the earth's magnetic field. The comparison may be made by means of the tangent galvanometer, and is often called the tangent-galvanometer method.

Or, we can calculate the force of attraction between circuits carrying electrical currents, and determine the current by measuring the forces of attraction experimentally; this is called the electrodynamometer or current-balance method. The potential energy of two circuits relative to one another is equal to $I_1 I_2 M$ where I_1 and I_2 are the strengths of the currents flowing in the two circuits and M is the flux of magnetic force through one circuit produced by a unit current in the other, that is, the mutual inductance. The force or torque between the two circuits tending to produce a displacement is measured by the rate of change of the potential energy. If the currents are constant, we have to consider, therefore, only the rate of change of the mutual inductance. If a particular displacement be represented by a change dx in the variable x, and the current is the same in the two circuits, the force

$$F = I^2 \, {}^{dM}/_{dx} = KI^2,$$

where K is a function only of the ratios of the dimensions of the electrical circuit. To measure the current I, the force F must be measured and K must be determined. As to the method of measuring F and determining K, the various types of instruments differ.

The force or torque may be balanced by (*a*) the elastic deformation of a wire or fiber; (*b*) the gravitational attraction of the earth. Then the torque or force must in turn be evaluated in absolute units.

K may be determined in three ways: (*c*) by measurements of the separate dimensions of the instrument; (*d*) by comparisons of the instrument with some other instrument, the dimensions of which can better be measured; (*e*) by measurements of the ratios of the dimensions which enter into K. The accuracy attainable with the instrument depends upon the possible accuracy of these determinations.

The method (*a*) requires a direct determination of the force of restitution of the deformed body (generally a fiber) as it was used in the electrical measurements. The elastic after-effects shown by all material bodies introduce formidable difficulties.

The method (*b*) requires the measurement of a force by weighing, and the absolute value of the acceleration of gravity. The first is capable of extreme precision. An accurate determination of the second is very difficult, but results obtained with this method at different times and places can be very accurately compared by relative determinations of the acceleration of gravity and may be corrected at any time when the absolute value is determined to a higher degree of accuracy.

The determination of the constant K by the method given in (*c*) requires that the geometrical form of the apparatus be simple and the dimensions relatively large. Thus, the use of single-layer coils is necessitated in general. The forces of attraction are usually small and can, therefore, be measured accurately only with difficulty. Furthermore, the constant is determined once for all and must be assumed to remain constant.

The method (*d*) allows the use of multiple-layer coils and some other features which tend to give a high sensibility in non-absolute instruments. The limitations of simplicity of form are, however, imposed upon a second apparatus with which the instrument itself is compared.

The method (*e*) allows the use of multiple-layer coils and the resulting high sensibility. The ratios which enter into the constant of the instrument may be determined experimentally by methods which are comparative and allow an extreme precision. The constant can be redetermined at any time.

The Rayleigh type of current balance as used in this work embodies the advantages of the methods (*b*) and (*c*). It consists essentially of three multiple-layer coils of square cross-section; two large fixed coils and a smaller moving coil. All of the coils are coaxial and their planes are horizontal. In this work three pairs of fixed coils (50, 50 and 40 centimeters in diameter) and three moving coils (25, 25 and 20 centimeters) were used. The moving coil was suspended midway between the other two from one pan of a precision balance. The current was led in and out of the moving coil at the balance pan by means of fifty silver wires. These wires were slack and, on account of their fineness, did not interfere sensibly with the oscillations of the balance.

The force exerted upon the moving coil by the current in the fixed coils was weighed by means of the balance, as follows: The strength and the direction of the current in the coils were arranged so that the moving coil was pulled down by a force of about three grams. This force and the weight of the moving coil were counter-balanced. Then the rest point a of the balance was determined. The current was then reversed in the fixed coils alone. The force then became a pull up instead of down, giving a change of about six grams. A weight of six grams was put on one pan of the balance from which the moving coil was suspended, and very nearly compensated for the change in the force. Another rest point b was taken, the difference between a and b gave the difference between six grams and twice the electrical force upon the moving coil. The drift of the balance was eliminated by taking a series of the rest points a and b and plotting these against the time.

The determination of the force in absolute units required the knowledge of the absolute value of the acceleration of gravity. The value at the Bureau of Standards was determined in terms of the value at the United States Coast and Geodetic Survey by William H. Berger. G. R. Putnam of the Survey has connected the latter value with Potsdam by relative pendulum observa-

tions. Thus, the value at the Bureau of Standards has been referred to Potsdam, where, as the result of a long series of observations, the absolute value is believed to be known to three parts in a million. On this basis, the absolute value at the current balance is 980.091 centimeters per second per second, and is probably correct to five or six parts in a million.

As seen before, the constant K is the rate of change of the mutual inductance with the displacement of one circuit in that direction in which we wish to determine the force. In the present case then, K is the rate of change of the mutual inductance of two co-axial circular coils, with the displacement of one coil in the direction of the common axis. Furthermore, at a certain distance the force is a maximum, and the coils of the Bureau of Standards current balance were spaced so that this condition was satisfied. In this case the force becomes practically a function determined solely by the *ratio of the radii* of the two circles.

The determination of this ratio is then the important point in the determination of the constant of the instrument. It was determined experimentally by methods which admit of extreme accuracy. The coils to be compared were adjusted concentric and coplanar, with their planes vertical and in the magnetic meridian. Most of these adjustments were made experimentally. Currents were then passed through the two coils in opposite sense and adjusted until the resultant magnetic field at the center was zero. This was indicated by a magnetometer needle, two millimeters long. The ratio of the two currents which balance each other in this manner is equal to the inverse ratio of the galvanometer constants of the two coils, excepting for a small correction on account of the length of the needle. The ratio of the galvanometer constants gives the ratio of the two mean radii when the numbers of turns and the sectional dimensions of the coils are known.

The ratio of the current was measured in two ways. The first method consisted in a simultaneous measurement of the two currents by means of two potentiometers. The second method was employed in cases where, as designed, the coils had nearly the same galvanometer constants. In this method the two coils are joined in series in such a manner that the current flows through them in opposite sense, one being shunted for a balance. As used in this work both methods permitted an accuracy of about two parts in a million.

One of the features of the current balance which contributed very strongly to the attainment of a high accuracy is the water cooling system. In each of the fixed coils there is a channel back of the windings through which water can be circulated to carry away the heat generated by the electric current. The supply of water was held at a constant temperature by means of a thermostat, thus maintaining the coils at a constant temperature and radius. Water circulated through the fixed coils while the constant was being determined and when weighings of the force were being made. During the latter experiment the moving coil was surrounded by a copper water jacket through which water from the same source was circulated. This served the purpose of carrying away the heat generated in the moving coil and also made constant the convection currents of air which were set up by the heating of the coil. The possible accuracy in the weighing was thereby considerably increased. By the method of weighing, the constant lifting force of the currents of air was eliminated.

The rest points of the balance were read by means of a telescope and scale and a small mirror mounted upon the central knife edge of the balance.

Since the intensity of a current cannot be represented by a concrete standard, two expedients have been adopted to preserve the results of the absolute measurement of current. One is to determine the mass of silver deposited per second in a silver voltameter by a current of one absolute ampere, the other is to determine the electromotive force of a standard cell in terms of a standard of resistance and the absolute ampere. In this work the electromotive force of the Weston normal cell at 20 degrees centigrade was determined in terms of the international ohm and the absolute ampere. The authors have called the unit of electromotive force a semi-absolute volt. Also, the final result has been expressed in terms of the electrochemical equivalent of silver as determined by a large number of observations with two types of voltameters at the Bureau of Standards.

In the final work four combinations of coils were used, besides one which was not used in taking the mean, owing to a very slight uncertainty in its cross-sectional area.

The conclusion is that the electromotive force of the Bureau of Standards concrete realization of the mean Weston normal cell at 20 degrees centigrade, was 1.01822 semi-absolute volts. We believe that it is a conservative estimate to assign to the value given above a possible uncertainty due to all causes of two in 100,000.

Other observers in England, France and Holland have recently published results obtained by means of various types of instruments. When reduced to the same basis as used above, the values obtained are as follows:

Date.	Observers.	Volts.
1907	Ayrton, Mather and Smith	1.01818
1908	Janet, Laporte and Jouaust	1.01834
1908	Guillet	1.01812
1908	Pellat	1.01831
1910	Haga and Boerema	1.01825
Mean		1.01824

The absolute value of the electrochemical equivalent of silver as obtained from the current balance of the Bureau of Standards and 159 silver deposits made by Rosa, Vinal and McDaniel in this laboratory with two types of voltameters is 1.11804 milligrams per coulomb. The value adopted by the London Conference in 1908 was 1.11800. In other words, the international ampere as defined by means of the silver voltameter, as used at the Bureau of Standards, differs from the absolute ampere, as realized there by means of the current balance, by only four parts in 100,000.

When the absolute value of the international ohm is as accurately known as the absolute value of the international ampere is now known, the watt can be realized with high precision from the international watt, by applying as a correction the small difference between them. Even now the most accurate way of measuring energy or power in absolute units is by means of electrical instruments.

Pennsylvania Coal Output.

Pennsylvania was the first producer of coal, in 1814, and has been by far the largest producer in the United States, according to the United States Geological Survey, having now a record which surpasses all foreign countries except England and Germany. Pennsylvania's total production since the beginning of mining has been 4,432,071,767 short tons, or more than one-half of the total production of the United States.

DIVERSITY-FACTOR AND FIXED CHARGES.

BY RENZO NORSA.

Considerable attention has been paid lately to the study of the diversity-factor, its importance in central-station economics being universally recognized. A definition of this term has recently been adopted in the Standardization Rules of the American Institute of Electrical Engineers.[1] We are also indebted to different authors for some valuable contributions on the subject.[2]

The most important points which have been brought out may be briefly summarized as follows.

First; starting out from the consumer's premises and passing through the different links (as distributing transformers, feeders, transmission lines) which connect the supply to the generation of the electric current, we find that different diversity-factors can be distinguished, corresponding to the ratios existing between the sum of the demands of the elements of each subdivision and their actual combined maximum demand. Thus, while a diversity-factor higher than 3 has been found in Chicago among residence lighting consumers supplied by one single distributing transformer, the diversity among feeders is only a little over unity.

The second important point which has been brought out is the effect of the diversity-factor upon the load-factor, the relation existing between these two terms being generally expressed by saying that the load-factor increases about in the same ratio as the diversity-factor. This relation will be further discussed in the following.

It is well known that unity load-factor is the most efficient condition for the operation of a generating station and of a distributing system. If this condition were attainable and if the use of electricity by the different consumers were continuous and steady, the problem of electric rates would be very simple. But the requirements made by the different consumers upon the central station vary in steadiness, in magnitude and in time and thus the question arises how the fixed charges must be prorated among the different users. The apportioning of fixed charges is, as a matter of fact, the real substance of the rate problem.

Take, for instance, the largely debated question of small and large customers. The basis for solving this question is to be found in the law of investment costs. If it will be kept in mind that the laws of cost do not generally follow a straight line, but, on the contrary, additions and extensions can mostly be made with lower increment costs per unit, the correctness, all other things being equal, of lower prices being allowed to larger users will be apparent. Again take the questions of relative prices for peak load and totally or partially off-the-peak load; the problem is to determine the different responsibilities of different classes of consumers for the investment costs. In both cases the kernel of the question is consequently how to divide and distribute equitably the fixed charges.

The diversity-factor, since it was first introduced in the study of rates, has been considered as a proper means for passing from the capital costs per kilowatt of demand made on the central station to the fixed charges corresponding to individual consumers.

Arthur Wright, in his well known study of the Brighton System, used for the first time the diversity-factor in rate making. The diversity-factor of the aggregate of all consumers was 1.46. The stand-by charges per kilowatt maximum demand made on the central station were figured to be $73.70 per year. Dividing 73.70 by 1.46 the "correct annual charge for standing by," per kilowatt maximum demand of consumer, that is $50.47, was obtained.

The Hopkinson and the Wright systems of charging (which, as is well known, are two expressions of the same fundamental idea) are extensively used in modern central-station practice. As a matter of fact the most elaborate systems of rates at present employed are simply a modification of the Hopkinson system obtained by the use of a double sliding scale both on the capacity and on the output charges.

The significance of the diversity-factor is that it represents numerically the combined effect, on the central station, of a class of consumers. The individual consumers belonging to this class might exceptionally have the same load-factor. Generally, however, individual load-factors will be different, hence the tendency in scientific rate making is to charge each customer according to the load-factor of his particular plant. It is now intended to discuss if it is proper to use the same diversity-factor in apportioning the fixed charges among customers having different load-factors.

We will start with a few examples, which will give an outline of the question. Take for instance a distributing system like the classical Brighton system which has already been referred to. The fixed charges per customer are found by the use of the diversity-factor, the energy being charged at a constant price per kilowatt-hour. The purpose of the rate, either in the Hopkinson or in the corresponding Wright form, is to differentiate between short and long-hour users. Now it may be seen easily that the result of applying one single diversity-factor to consumers who, although belonging to the same class as for instance residence lighting, may have different load-factors, is a discrimination favoring excessively the long-hour users. In fact suppose that among all the customers whose load-factor is generally low and whose aggregate diversity-factor is for instance 3, there be some consumer having a very steady load and consequently a very high load-factor. It is apparent that this consumer does not contribute at all to the average diversity and therefore the fixed charges figured as shown above are too low for the long-hour users and consequently too high for the short-hour users. Or in other words the long-hour users are given the privilege of sharing with the short-hour users the advantage of the aggregate diversity, while this diversity is due only to the customers making a short or an irregular use of the electrical energy.

Another example, which although assuming some rather unusual conditions, still brings out clearly the point which we are considering, is the following. Assume a central station supplying three consumers, the supply of electric current being made to the first consumer from 8 a. m. to 4 p. m., to the second from 4 p. m. to 12 p. m., and to the third from 12 p. m. to 8 a m. Each consumer makes the same demand upon the station and has a steady load. The load-factor of the central station is consequently 1. The diversity factor is 3, and the fixed charges are found

1 Diversity-factor is the ratio of the sum of the maximum power demands of the subdivisions of any system or part of a system, to the maximum demand of the whole system or the part of the system under consideration, measured at the point of supply.

2 See: H. B. Gear. *Transactions*, A. I. E. E., XXIX, page 375. 1910; and also a paper by C. J. Russell read before the Philadelphia section of the N. E. L. A.

by dividing by 3 the fixed costs per kilowatt demand upon the station. In this case the load-factor of each customer is 0.33 and there is no doubt that the apportionment of the fixed charges made on the basis of the aggregate diversity-factor is correct and equitable. But now suppose that the consumers be only two, one using the current for eight hours, and the other for the remaining sixteen hours, both again with the same demand and with a steady load; then the load-factors would be 0.33 for the eight-hour consumer and 0.67 for the sixteen-hour consumer, and the diversity-factor, according to the definition, would be 2. It is apparent that if the apportioning of fixed charges should now be made according to the aggregate diversity of these two consumers having different load-factors, the sixteen-hour user would contribute too little to the fixed costs, and the eight-hour user would contribute too much. In fact, the sixteen-hour user would pay less than two eight-hour users paid in the first case, while on the contrary the eight-hour user would pay more than in the first case.

These two examples point out clearly the difficulties presented by the problem of prorating the fixed charges among the different consumers. It can also be seen that the diversity-factor, generally considered (diversities among classes at the time of the peak being so far neglected), is not exactly a proper measure of the individual responsibilities of single customers for the capital costs.

This objection to the use of the diversity-factor in rate problems had not failed of being noticed even by the originators of the demand system of charging. In fact, in a paper presented by Mr. Wright before the Institution of Electrical Engineers as far back as 1901, the necessity of an allowance to be made to the short-hour users and to the intermittent users on account of their probable larger diversity is admitted, and the use of very sluggish demand indicators is suggested, requiring that the load be maintained for at least one hour to be fully registered. But as far as the writer knows, the time lag in maximum-demand indicators, as they are now constructed, is of four or five minutes only, this being the time required by the indicator to record about ninety per cent of the load; that is, the time-lag curve rises very rapidly from zero to nearly the actual load in only a few minutes, although a considerable time is then required to get from 90 to 100 per cent.

Summing up the points brought out in the foregoing, it can be said that if the consumers, as is the general case, have different load-factors, the diversity-factor is no more a measure of their individual responsibilities for the maximum demand made upon the central station, but it is only a measure of their collective or combined effect. In other words if 100 customers are supplied, each having a demand of 10 kilowatts and if the diversity-factor is 2, the effect on the central station will be 500 kilowatts. It cannot, however, be said that each customer, irrespectively of his own load-factor, will be, as an individual, equally responsible for the cost of five kilowatts of central station demand.

We can now proceed to discuss the problem of diversities more generally.

As a matter of fact there are two different kinds of diversity[3], which for the purpose of our study, must be taken up separately; there is a general diversity and a time-of-day diversity[4]. The general diversity depends upon the casual or accidental time displacement of customers' demands on account of their intermittent or irregular use of the current. The time-of-day diversity, on the contrary, is originated from the fact that the current may be used by single customers or classes of consumers at different times of the day, a greater supply being required at certain definite hours (as the first night hours for electric lighting or rush hours for electric transportation) and a very small supply during other hours. Thus there is a time-of-day diversity between power load and lighting load; but power customers, using the current during the same hours have a general diversity among themselves, and likewise lighting consumers have a general diversity among themselves. Leaving aside for the moment the time-of-day diversity, let us take up the general diversity.

The advantage of considering separately the general diversity and the time-of-day diversity is that the question of general diversity can be discussed by elementary methods of reasoning such as are extensively used in statistics. In fact, the problem of general diversity is a problem in pure chance, and problems of probability, as it is well known, are largely applied in statistical investigations.[5]

If we toss a certain number of coins, it may happen that all heads turn up at the same time; generally, however, only a certain part of the total number of heads will turn up. In the same way, if we consider a certain number of consumers of electric current, it is possible that all their demands come at the same time, but, as a matter of fact, we find that individual demands are generally more or less displaced. In some cases, however, the demands will be necessarily coincidental as for instance they would be if all consumers should use the current steadily and continuously.

Frequency is called in statistics the number of occurrences of an event. Frequency laws may be represented graphically by frequency polygons, a frequency polygon being obtained by drawing along a horizontal line at equal intervals a series of ordinates, whose heights are proportional to the different frequencies and joining the tops of these ordinates. For instance, if we toss five coins a certain number of times, we might represent graphically through a frequency polygon how many times five heads, how many times four heads, three or two or one single head, or no heads turned up.

The relation between frequency and chance is that in the long run the proportional frequencies of actual occurrences will correspond to the probabilities of the occurrences.[6]

By considering the question of diversity as a problem of chance, we will now proceed to investigate how the frequency of coincidental demands depends upon the elements which are of interest in problems of rates, that is load factor and magnitude of demand of single consumers. Without attempting to put the question under a mathematical form, we shall confine ourselves to a few examples taken from the theory of probabilities.

Suppose for instance that there are four bags, each one of which contains

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3 The term diversity is used hereafter with a more general meaning than diversity-factor, the last involving the idea of an aggregate effect, while diversity may as well refer to individual responsibility.

4 Seasonal diversities (or time-of-the-year diversities) are not considered in this article and are rarely taken into account in rates.

5 It is interesting to note that the possibility of using the theory of probabilities for the purpose of investigating the question of diversity was mentioned by Mr. A. Wright himself, in the article quoted above. (*Journal Institution Electrical Engineers*, XXXI, page 444; 1901.)

6 When frequencies are indefinitely increased, frequency polygons tend to become a smooth bell-shaped curve, that is, a curve which, starting from zero, increases more or less rapidly to a maximum and then falls again to zero.

three black balls and one white ball. Let one ball be drawn from each bag and the number of black balls recorded. Then let the four balls be replaced in the bags and four balls drawn again and each time the number of black balls recorded. In the long run the frequency polygon would have ordinates proportional to the following figures: frequency 1 corresponding to four white balls drawn at the same time; frequency 12 corresponding to one black and three white; 54 for two black and two white; 108 for three black and one white; 81 for four black balls.

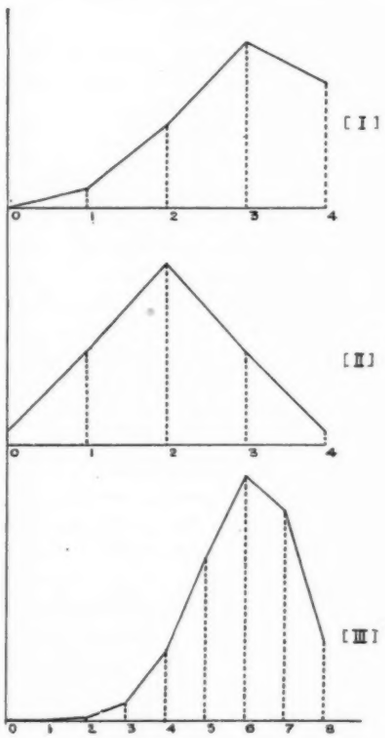
Suppose now that two bags should contain three black and one white ball each and the two other one black and three white balls each. The frequency polygon would then have as ordinates: 9 corresponding to four white balls; 60 for one black and three white; 118 for two black and two white; 60 for three black and one white; 9 for four black balls.

By comparing these two examples we see that there is a certain definite combination of black and white balls which is repeated the most of the times. In the first case this was three black and one white; in the second case two black and two white. Consequently we see that the combination that will appear more frequently corresponds to the ratio of the total number of black balls to the total number of white balls contained in all four bags.

Another result is that in the second case the frequency corresponding to three black and one white ball is much lower than in the first case, the reason being naturally that in the second case two bags contain one black and three white balls, while in the first case all four bags contained three black and one white balls.

Now how can the problem of diversity in the electric supply be compared with the above examples? Take for instance, a certain number of consumers supplied by one single distributing transformer (the individual load factor of these consumers, it is supposed, being different from unity). It is possible that for a few instants every day all their demands actually happen to be coincidental, but the frequency corresponding to this event is so low that it will have no appreciable effect upon the transformer. Then it will happen more frequently that only a certain part of the aggregate demands of the consumer be coincidental; again we will find that a still smaller percentage of the aggregate demand will be still more frequently coincidental and so forth. Thus, a certain coincidental demand will be reached which will be frequent enough to require that the capacity of the distributing transformer be proportionate to this demand; if, for example, this demand should be fifty-five per cent of the aggregate of the consumers' demands, we would say that the capacity of the transformer was determined according to a diversity-factor 100 : 55=1.82.

Thus it is evident that there is an



FREQUENCY DIAGRAM.

analogy between the two examples given above and the case of the supply of electricity to a certain number of consumers using the electric current more or less irregularly.

As a consequence of the general diversity among these consumers, the demand made upon the central station will tend to become constant, or else the central station load-factor will tend to become unity. The greater the number of customers supplied, the more constant the demand will become and the nearer the load-factor will approach unity.

From the second example we see that if some consumers supplied by an electric generating station have a high load-factor and some others a low load-factor, the demand most frequently made upon the central station will have a lower value than if all customers had a high load-factor. The consequence is that on a strict responsibility basis, the fixed charges cannot be equitably prorated among customers according to an aggregate diversity-factor; but in sharing capital costs, the burden laid on low load-factor customers should be smaller than the burden laid on high load-factor customers.

We will now inquire what is the relation between diversity and magnitude of consumers' demand. It is apparent that, as diversity is concerned, the difference which may exist between large and small consumers is dependent not on the size but on the number of customers which are supplied by the generating station. In fact, there is no reason for the diversity-factor of a group of large customers being lower than the diversity-factor of a group of small customers, if the number of customers in these two groups and the characters of their load diagrams are the same. But if a certain definite total capacity of generating station is considered, and this capacity is supplied either to a small number of large consumers or to a large number of small consumers, then it is obvious that the diversity will be much greater in the second case.

This may be illustrated again by the theory of probabilities. Compare for instance, with the first example, the following in which eight bags are supposed to be taken, each one containing again three black balls and one white ball. The law of frequency will then be expressed by the following figures, to which the ordinates of the frequency polygon are proportional: 1 for eight white balls drawn at the same time; 24 for one black, seven white balls; 252 for two black, six white; 1,512 for three black and five white; 5,670 for four black and four white; 13,608 for five black and three white; 20,412 for six black and two white; 17,496 for seven black and one white; 6,561 for eight black. The frequency polygons corresponding to the three examples given are plotted in the accompanying diagrams having as abscissae the number of black balls drawn at the same time, and having ordinates proportional to the frequencies.

From the above figures we see that, although the proportion of black, and white balls in the bags is the same as

in the first example, still on account of the greater number of bags, the relative proportion of cases in which all balls drawn are black becomes much smaller. That means that the frequency polygon is spread out now much less than it was when we were dealing with four bags only.

Therefore (all other things being equal), a variation from the average coincidental demand is much more likely to happen for a class of large customers than for a class of small users, because for a given capacity delivered from the central station the class of large users is necessarily composed of a smaller number of individuals.

So far we have been dealing only with the general diversity; we must next consider the time-of-day diversity. Different classes of consumers may use the current at different times of the day and this fact is expressed by saying that there is a time-of-day diversity among these classes. The time-of-day diversity is no more a casual or accidental displacement but on the contrary depends on certain definite reasons or circumstances.

This diversity must obviously be considered in prorating the fixed charges among the different classes. But when we come to the apportionment among the individual consumers within a class, as for instance lighting consumers or power consumers, then a general diversity will exist among these consumers exactly as noted before. Naturally, if the use of electricity, instead of being possible at any moment of the day, is confined within narrow limits of time, the aggregate diversity-factor of all individuals belonging to a certain class will become lower; that is, it will more easily happen that the demands of different consumers be coincidental. But the individual responsibilities (to be taken in account in prorating among the individuals of the class the fixed costs chargeable to the whole class) will still be dependent upon the individual regularity or steadiness in the use of the current.

A practical example of the relation between individual load-factor and individual diversity is the following.

Let us consider the electric signs connected to a distributing system. If all signs are lighted during the same hours, it will be correct to assume that this class of business, as a whole, has a certain responsibility for the capital costs. But within the class, we find that some signs are lighted continuously and some others are flashed. If now the class of electric signs has a diversity-factor higher than 1, this is due only to the signs of the flasher type and not to the signs which are burned steadily. Consequently, responsibilities of individual customers in sharing the burden of fixed costs laid upon the class should be made proportional to their load-factors. In other words, the rate would be simply a meter rate; a Wright or a Hopkinson rate would lay excessive burden upon the signs of the flasher type.

The conclusions which may be drawn from the foregoing analysis may be summarized as follows:

(1) The question of diversity-factor is very important in central-station economics. It can be said that both centralized production and diversity-factor are the economical reasons of the existence of the central station. This last point is often neglected by the advocates of isolated plants, and in fact, we often hear of the cost per kilowatt maximum demand on an isolated plant being compared with the cost per kilowatt maximum demand at a central station, the last being found generally higher on account of the investment in the distributing system. To make a comparison on an equitable basis, the cost per kilowatt maximum demand on an isolated plant must be compared with the cost per kilowatt customer's demand.

(2) Increasing the diversity-factor means improving the load-factor, but improved load-factor is not necessarily a consequence of increased diversity-factor. Thus, a central station supplying a certain number of consumers, all making a steady and continuous use of the current, would have unity load-factor and still have only 1 as diversity-factor.

(3) When we come to the problem of rate making, we find that the diversity-factor, as defined in the Standardization Rules of the American Institute of Electrical Engineers is a measure of the aggregate effect upon the station of all customers or of a group of customers, but is not the proper measure of their individual responsibilities, which should be taken in account in sharing the burden of fixed costs.

It is consequently obvious that in all the systems of charging of the Hopkinson-Wright type, consumption and capacity expenses are dealt with differently. In fact, the consumption charges are based on a rule of individual responsibility, the energy consumed by each individual customer being metered and charged at a cost which is approximately the cost of producing it. On the other side, the capacity charges are fixed on the basis of the aggregate effect (of all customers or of a group of customers, as lighting or power users) on the central station; that is to say, they are not fixed according to an individual responsibility, but rather according to an average responsibility.

By the above criticism the writer does not intend to discredit the classical system of rates which is based on a demand charge and on an energy charge, but rather to point out that there are some very strong objections against the advisability of strictly following in the apportionment of costs for rate making, such general rules as are often claimed to be scientifically correct and equitable. The problem of rates is by no means a problem for which a general solution can be given.

As a matter of fact the stand-by system of charging would be correct, if there were not such a thing as diversity. A typical example of a system in which there is actually no diversity is a single office telephone plant, each subscriber being the exclusive user of a certain part of the plant, and being consequently responsible for the corresponding investment cost. When we come to a multi-office system, then the diversity comes in as time displacement in the use of the trunks among the different exchanges. In an electric system for power and light supply, diversity affects generally all the generating and distributing system.

It is, however, possible that there be no diversity even in an electric system; that may happen in two cases: (1) if there is no general diversity; (2) if there is no time-of-day diversity.

The first case means that all customers make a continuous and steady use of the current. This case has not practical interest and would be very simple from the rate-making point of view.

The second case, on the contrary, is very important. It means that all customers require the supply of current at a certain definite moment of the day, the consequence being that the central station has a very high peak of short duration and consequently a very poor

load-factor. The maximum system of charging is now undoubtedly appropriate and equitable.

The opposite case is that the diversity among customers be so high, to make the demand on the central station steady that is to say the load-factor unity. In this case the maximum-demand system of charging would be unfair, because it is apparent that the responsibilities of individual consumers for the capital costs are proportional to their load-factors. Consequently the effect of applying the demand system will be that the short-hour users will contribute too much to the capital costs and long-hour users will contribute too little.

These remarks bring out an important point, which is that a central station's load-factor should be considered in determining rate systems, not only for the purpose of fixing the numerical values of the charges, but also for selecting the proper form of the schedule. That is to say, the relative importance to be given to the kilowatt charge and to the kilowatt-hour charge, should be made dependent upon the general conditions of operation of the electric system as represented by the central-station load-factor.

Therefore, a strict maximum-demand system will be appropriate for systems having a high peak of short duration; *e. g.* small central stations, the greater part of whose business is the supply of current to lighting consumers. As a matter of fact such were exactly the conditions of the Brighton system, where the Wright method of charging was originally applied.

But the more the central station's load-factor increases, the less it becomes appropriate to adhere strictly to the maximum-demand system. We often hear the words desirable and undesirable customer used as synonymous of long and short-hour users. This is correct for a small central station operated with a low load-factor, but in a large system operated with a considerably higher load-factor all users will be about equally desirable. Therefore, larger systems, having the advantage of a great diversity and being able to secure different kinds of business and thus to gradually improve their load-factors, should not discourage the short-hour users by excessively high capacity charges.

To sum up, it seems to the writer that rate makers are often inclined to lay too much importance on the stand-by charges and too little on the consumption charges, the consequence being that the price per kilowatt-hour is made too low and the price per kilowatt too high. If the points set forth in this article will be accepted, it must be clear that in rate-making it is neither equitable nor convenient to burden all capital costs on the capacity charge, or, respectively, on the higher price applied to the first hours of use. At least a certain part of the capital cost should, on the contrary, be spread over the energy actually consumed by the customers, which means that it should be included in the consumption charge.

What is the Height of a Dam?

It is rather surprising to find that there is no rigid rule for measuring the height of a dam. Although possibly one-third of all the water-power suits relate to the height of the dam or stage of water there seems to be absolutely no judicial decision on the subject.

In reply to a request for his opinion on this much discussed question, Charles T. Main, engineer of Boston, who is an authority on water-power developments, states that the height of a dam usually means the height from the bed of the river at its lowest point to the crest of the dam. That is the height of the physical structure. The height usually varies from the point of maximum, decreasing as it approaches the banks of the river on either side. It usually has nothing to do with the fall or the power produced, as for example, in a development in which water is carried for some distance through canals, penstocks, or flumes, the dam which diverts the water from the river at the head works into conduits may be only a few feet high, whereas the head is the difference between the level of the water at the end of the conduit, usually in a terminal reservoir if the distance is long, and the surface of the water in the river below the station.

It is only in such developments as when the whole head is created by the construction of a dam that the height of the dam approximates the head producing power. In some instances it is necessary to go to a considerable distance below the bed of the stream for a foundation for a dam, but the depth of the foundation below the bed, in Mr. Main's opinion, should not be included in the height of the dam.

LETTER TO THE EDITOR.

Characteristics of Metal Lamps and Meter Registration.

To the Editor:

Supplementary to my contribution published in your issue of November 11, "Some Operating Characteristics of Metal-Filament Lamps," it appears that there is considerable opportunity for misinterpretation of the statements covering the overshooting of current in such lamps, and the relation of this characteristic to meter registration.

The data and tests in this article refer to lamps rated at 25 watts and 108 volts. This characteristic is greatly affected by conditions both internal and external to the lamp. The internal condition having the highest value, would be the variation in the diameter of the filament with the voltage and candlepower of the lamps. External conditions having the highest value would be the amount of resistance or impedance in the circuit supplying the lamps, and whether a transformer or direct current was used for the current supply, and the design of the meter used. The first two conditions alter the characteristics of overshooting greatly, by limiting the energy rush, while the relation of the torque to the weight of the moving element in a meter will further complicate the operating results.

J. FRANK MARTIN.

Pittsburg, Pa., December 13, 1911.

Fungus Growth on Rubber Insulation.

The fungus growth which sometimes appears on rubber insulation was briefly discussed in a recent issue of the *India Rubber World*. This growth takes place sometimes even when the insulated wires are inclosed in a conduit of enameled iron. The fungus growth, which destroys the insulation, is promoted by iron rust, which, with the consequent fungus growth, is impossible except where there is some moisture. The remedy therefore is to insure the dryness of the tube interior by blowing hot air through it, and then all future possibility of dampness must be prevented. If it is impossible under the circumstances to keep the inside of the tube dry a good quality of red lead paint is the best preventive of damp and fungi.

A passenger elevator will be installed in the Hotel Tivoli at Ancon, Canal Zone. It is to be operated by electricity.

Central-Station Practice

OUTDOOR TRANSFORMERS AND SWITCHING STATIONS.—I.

BY STEPHEN Q. HAYES.

The question of outdoor transformers, switchgear and protective devices is well worth careful investigation by engineers and operators responsible for high-voltage installations where it is essential to keep the first cost of the installations down to a minimum and this article has been prepared to deal with this subject under the following

FIG. 1.—33,000-VOLT TRANSFORMER.

headings: outdoor transformers, outdoor fuses, outdoor oil circuit-breakers, outdoor lightning arresters; actual outdoor installations; summary.

OUTDOOR TRANSFORMERS.

Until within the past few years, small distributing transformers and arc lamps were about the only high-voltage electrical apparatus exposed to the weather, but recently the tendency has grown to increase the amount of outdoor high-voltage apparatus and equipments. Distributing transformers in capacities up to fifty kilowatts for voltages up to 6,600 are fairly familiar to all electrical engineers, but for the larger capacities and higher voltages the designs are not so well known and may be of interest. It is the purpose of this paper to show some of the more interesting features of such outdoor transformers and switching apparatus, and the arrangements adopted for their satisfactory installation.

All transformers, in common with other electrical apparatus, develop heat in service, and this heat must be carried away as rapidly as developed in order to prevent an undue temperature rise. To facilitate the carrying off of this heat and to improve the insulation of the transformers, oil is used almost invariably when the voltage exceeds 33,000 and frequently for lower voltages, even with transformers of comparatively small capacity.

The oil by its circulation helps to carry off the heat developed in the windings and in the iron of the transformers, and practically acts as a means of conducting this heat from the transformer itself to the case where the heat is radiated into the air.

In moderate sizes of transformers a plain case furnishes sufficient radiating service to carry off all of the heat developed. Fig. 1 shows a 40-kilowatt 33,000-volt transformer in a plain case. The method shown of bringing out the high-tension leads through porcelain or other bushings placed vertically in the top of the case has been found necessary for all high-voltage outdoor apparatus, although for more moderate voltages, downward projecting leads covered by weather-proof bushings give fair satisfaction. This question of the proper outlet bushings is taken up somewhat later in this paper.

Where sufficient radiating service cannot be secured by a plain case, it is customary to adopt the corrugated construction shown in Fig. 2, which illustrates a 100-kilovolt-ampere, 55,000-volt transformer. The case of this transformer is made of corrugated sheet iron with welded vertical seams and the top and the bottom are cast on the corrugated sheets. This arrangement gives a strong oil-tight construction that is entirely satisfactory for outdoor service. The overhang of the cover secures the joint between it and the top of the case, and the cover is fitted with outlet terminals and small inspection doors. All joints are carefully protected by an overhang, and are designed for making tight by means of gaskets.

With this type of corrugated case, self-cooling transformers can be built

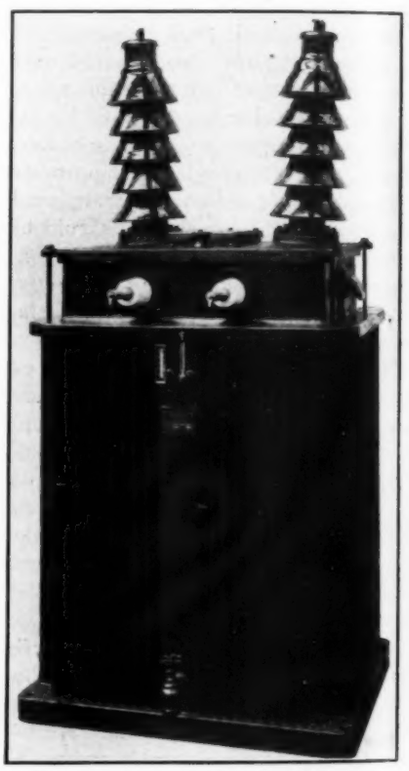


FIG. 2.—55,000-VOLT TRANSFORMER.

in capacities up to about 750-kilovolt-amperes and for a long time this marked the practical limit to the size of self-cooling transformers.

The latest development in the design of self-cooling transformers of large capacity is shown in Fig. 3, which illustrates a 2,000-kilovolt-ampere, 100,000-volt transformer with tubular tank case. As may be noted the case of this transformer consists essentially of a welded boiler-iron tank with a large number of tubes connected to the case near the top and the bottom. The cir-

culation of air around these tubes cools the oil contained in them and this cold oil flows in at the bottom of the tank while the heated oil in the transformer case flows from the tank into the top of the tubes. An excellent oil circulation is secured in this manner and the ample radiating surface due to this arrangement has made it possible to build self-cooling transformers of any size up to about 3,500-kilovolt-amperes, depending on voltage and frequency.

It is of course possible to use water-cooled transformers for outdoor service as well as for indoor, if proper provision is made for water circulation and care taken to guard against the water freezing in winter time.

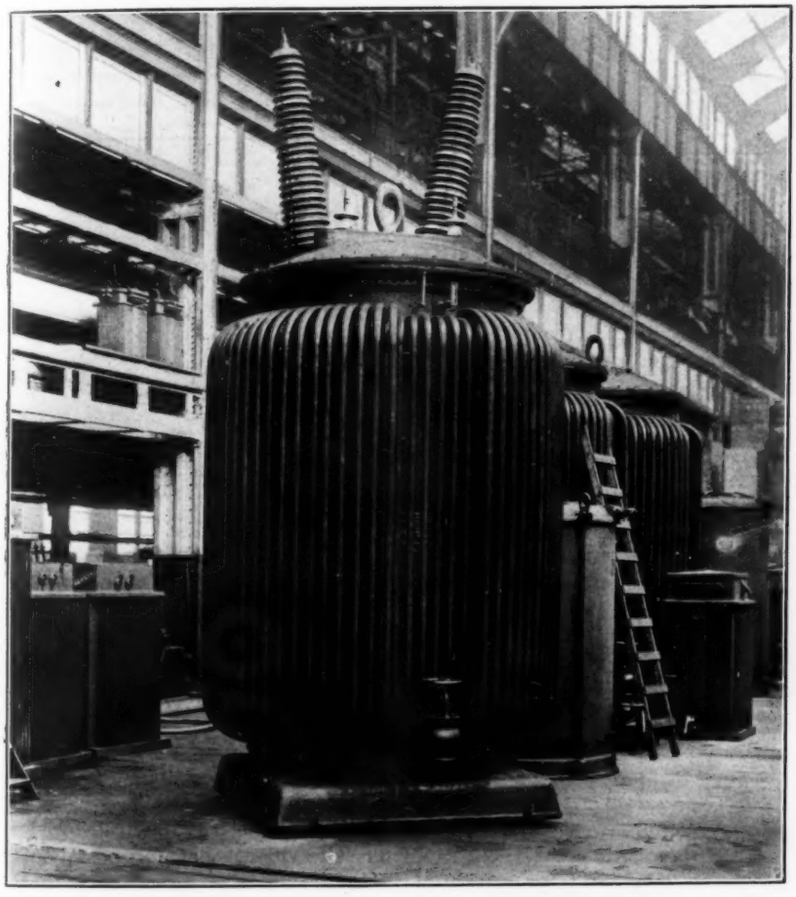


FIG. 3.—1,000-KILOWATT, 100,000-VOLT TRANSFORMER.

In actual service, outdoor transformers require the same care as indoor transformers. Thus, an occasional test of the oil is necessary and, when the weather and operating conditions permit, thorough and detailed inspections should be made.

In the summer time protection from the sun will be probably desirable, and this can usually be obtained by a simple wooden fence so placed and of sufficient height to cast a shadow over the transformer during the hottest portion of the day. At night the cooling conditions are so favorable that the heat accumulated during the day will be carried off and the transformer start cool each morning. The large amount of oil in self-cooled transformers will store up a considerable amount of heat and this acts in the nature of a fly-wheel for the system, tending to smooth out temperature fluctuations.

With water-cooled units, as most of the heat developed is carried off by the cooling water, shade is not essential for the transformers, and if attendance is at hand the temperature of the transformers can be held practically constant under varying loads and weather conditions if desired either by hand or by an automatic thermostatic control of the cooling water. In extreme winter weather, if there is any liability of the transformers being shut down for a considerable time, it is necessary to drain the cooling coils of their water, so that they cannot freeze.

The oil furnished with transformers will, as a rule, thicken at about zero centigrade, but it does not harden so as to damage the windings or case, but when cold the insulating quality of the oil is reduced, but not so much as to make it unfit for insulating purposes.

As a rule, however, the iron loss in a transformer will be sufficient to keep the oil fluid. In extremely cold weather, self-cooled units may be kept warm by wrapping them in burlap or similar material in order to reduce the effectiveness of their cooling surface and retain some of their heat, while water-cooled transformers may be operated with a greatly reduced flow or a complete shutting off of the cooling water.

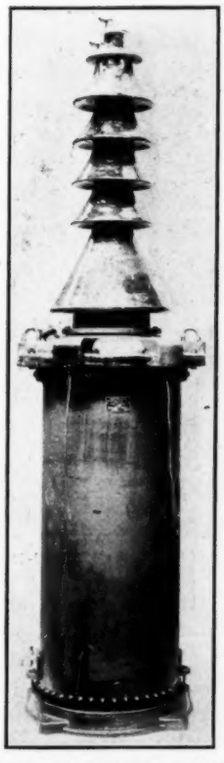


FIG. 4.—OUTDOOR SERIES TRANSFORMER.

In transformers and other outdoor apparatus, it is advisable to make all joints weather-proof, and for the extremely high-tension transformers, it is customary to make them vacuum-tight, while for lower-voltage transformers and circuit-breakers, this is not so essential. If there are no leaks in the case, nothing can enter, and therefore a clean unit will remain in this condition. Moisture in the form of rain, snow or humidity is to be guarded against, and the so-called "breathing" of wet air is the most important sort of

trouble, because it is the most difficult to overcome. As the transformer heats, part of the air at the top of the case will escape if any outlet exists and new air will enter as the temperature drops. Under certain conditions the moisture contained in the new air will condense inside the transformer case and the amount of moisture accumulating in a short time in this way is very surprising. Carefully made cases with deep overhanging eaves and carefully sealed-in outlets, give pretty good results.

In certain cases where it is not desirable to place the main transformers out of doors, it is possible to place the instrument transformers for large and

FIG. 6.—22,000-VOLT CIRCUIT-BREAKER.

important stations outside, and in this manner reduce the amount of building required.

Fig. 4 shows a 60,000-volt current transformer intended for outdoor service and used for furnishing currents for the operation of instruments and relays.

Probably the most important feature of high-voltage outdoor apparatus is the terminal furnished for carrying the current through the case. For voltages up to about 66,000, very satisfactory terminals can be made for transformers by building up a tube of insulating material in the usual manner and placing porcelain shields or covers over the tube and filling the space between the tube and the insulators with a moisture-proof compound. For voltages above 66,000 on transformers, and for voltages above 44,000 on oil circuit-breakers, a somewhat different type of terminal is usually supplied. The transformers and circuit-breakers described in this paper are provided with the so-called condenser-type terminals. This terminal consists of a rod or tube forming the conductor and sur-

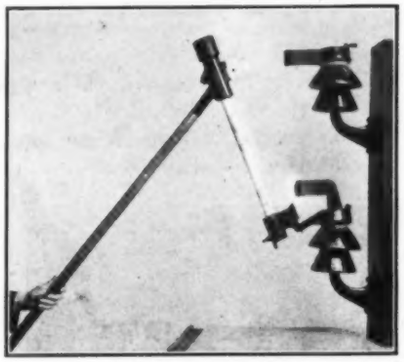


FIG. 5.—25,000-VOLT OUTDOOR FUSE.

rounded by a number of concentric condensers of predetermined capacity, arranged in such a manner that they are connected in series so that the fall of the static potential from the inner one, forming the line conductor, to the outer end, which is grounded to the case, is such as not to strain the insulating material beyond its dielectric strength. The rod or tube is surrounded by a layer of insulating material which in turn is covered by a thin layer of tin foil, the alternate layers of insulating material and tin foil forming the condensers. The ends of the terminal

FIG. 8.—88,000-VOLT CIRCUIT-BREAKER.

are tapered off in steps, one step at the end of each layer of tin foil and this arrangement of metallic cylinders fixes the potential difference between them and keeps it within the puncture strength of the insulation. As the edges of the metallic layer extend to the edges of the cylinder of insulation immediately surrounding it, the difference of potential along this surface is definitely fixed and can be kept less than the puncture strength of the surrounding medium, air or oil. These terminals are made by winding paper under heavy pressure and at a high temperature around the metallic rod or tube to form the conductor. The various layers are bonded by resinous gum and the temperature of manufacture is so high that the gum is melted making a perfect bond between adjacent layers, so that the tube when completed is one solid mass. As shown in some of the illustrations, this condenser type of terminal is adapted for outdoor service by covering the portion of the terminal projecting into the air by porcelain, filling in the space between the tube

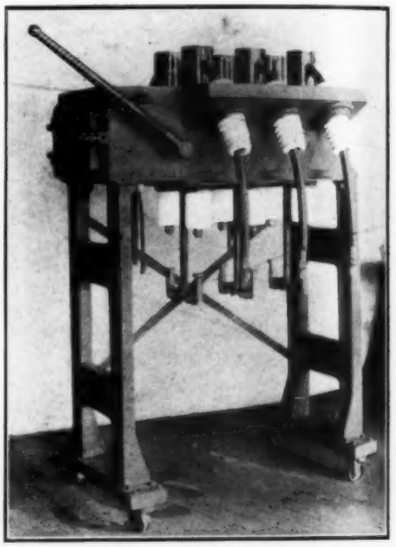


FIG. 7.—BREAKER WITH TANKS OFF.

and porcelain by a solid insulating material.

OUTDOOR FUSES.

In connection with transformers it is self-evident that for a satisfactory installation it is necessary to provide some means of protecting the transformers, and in case of necessity cutting them off from the transmission line.

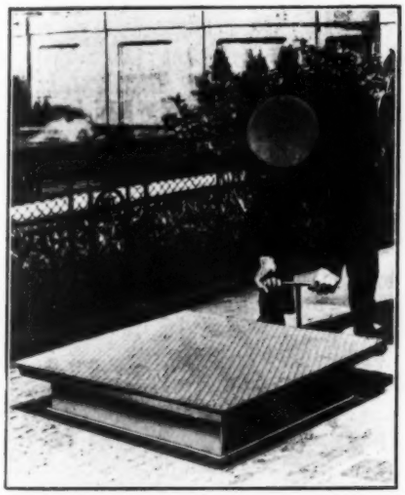
For small capacities and moderate voltages an outdoor type of fuse holder and fuse such as shown in Fig. 5 is entirely satisfactory. The fuse holder shown is intended for 25,000-volt outdoor service and modifications of this design can be built for even higher voltages, by using larger insulators and increasing the amount of insulation on the fuse tube. As may be noted, this fuse holder is arranged to act as a disconnecting switch as well as a fuse and

for moderate capacities and voltages this piece of apparatus gives very effective service.

The objection to a fuse or any similar single-pole device is that in a polyphase installation one wire only may be opened throwing an undue load across the other phases. It is moreover almost impossible to provide a fuse device of this kind that can be used to open a circuit of large capacity under load.

OUTDOOR OIL CIRCUIT-BREAKERS.

In order to handle large amounts of power at high voltages, outdoor oil circuit-breakers have been designed. Fig. 6 shows a three-pole, outdoor type, oil circuit-breaker built in capacities up to 300 amperes for voltages up to 25,000 volts. This breaker is a modification of the standard switchboard-mounting breaker and as may be noted



RAISING OR LOWERING ENTRANCE HOUSE.

the mechanism is completely covered up by weather-proof housing provided with an air pipe for ventilation. Automatic operation is obtained by means of a tripping device worked from the secondaries of current transformers located under the weather-proof housing. Each pole of the breaker has a separate oil tank provided with an oil gauge for observing the height and condition of the oil. The three small wires leaving the bottom of the housing are connected to the middle and two outside studs of a double-throw signal switch mechanically actuated by the mechanism of the breaker and these wires are used for lighting up signal lamps to show the open or closed position of the breaker.

Fig. 7 shows the same breaker with the oil tanks and housings removed. As may be noted, butt contacts are used, these being made of cylindrical brass rods, the lower one being backed up by the individual spiral springs to insure contact and to prevent any possible failure due to eating away of the contacts by continued arcing. The compression springs mentioned take up any wear that occurs and render the contact self-alining. The contacts are readily removed and replaced.

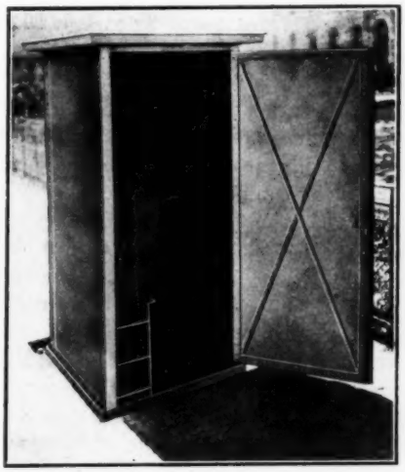
As mentioned previously, each pole of the circuit-breaker has independent tanks with live metal parts immersed in oil. These tanks have a lining so formed as to reduce the amount of oil required and to form a barrier between the two stationary contacts yet allowing ample space for the movement of the wooden arm and its contacts. Any one of these tanks can be easily removed without interfering in any way with the others.

For higher-voltage service, breakers with the condenser type of bushings are supplied and these can be readily arranged for outdoor mounting.

Fig. 8 shows one of the actual 88,000-volt outdoor circuit-breakers supplied to the Southern Power Company, and this breaker is provided with the condenser-bushing leads previously described. In this type of breaker each pole is located in a welded-steel tank with treated lining and is complete with all of its mechanism on its cast-iron top. As each pole is entirely independent, with the operating rods forming the only mechanical connections between the tanks, the spacing of the poles can be made to suit the wiring of the station. The operating mechanism of each pole consists of a toggle actuating a simple system of levers and links, with the pull rods connecting the poles so that all open and close with the same movement, and so that all adjustments can be made after the mechanism has been assembled on the cover, and before the latter is placed in the oil tank. This breaker has its stationary contacts deeply immersed in oil and screwed directly on the end of the brass tubes that form the leads through the condenser bushings. The movable contacts are self-alining and the contacts are provided with heavy springs that are compressed when the breaker is closed. These movable contacts are carried by heavy cross-bars and the current is transmitted through the braided shunts so that the compression springs will not be damaged by the passage of a current through them. When closing, a wiping motion is obtained until a solid butt contact is reached. Both the stationary and movable contacts are readily removable. All of the outdoor breakers can be arranged for hand operation or electrical operation as preferred.

One point that may be noticed in connection with these circuit-breakers is that the series transformers for the operation of ammeters and relays are clamped directly around the condenser-bushing leads which form the single-turn primary of the series transformer. This permits the use of a simple, compact and cheap form of transformer.

As a matter of interest it might be stated that outdoor, high-voltage breakers of this type are installed on the lines of the Dominion Power &



DISAPPEARING MANHOLE ENTRANCE.

Transmission Company near Hamilton, Ontario; the Niagara, Lockport & Ontario Power Company's lines near Niagara Falls, N. Y., and the Southern Power Company's lines in North Carolina and South Carolina.

(To be continued.)

Disappearing Vault Entrances.

A novel type of disappearing entrance for underground cable-junction boxes, transformer substations and the like is being introduced by the Ados Company, of Aix-la-Chapelle, Germany. It consists of a square manhole cover fitted with steel sides, which can be raised together so as to form an entrance house, with a ladder opposite the side which opens as a door. The whole movable portion is counterweighted so that a man can easily raise

or lower it in less than a minute's time.

The advantages claimed for such a movable man-hole entrance are twofold: First, it avoids the expense of transporting a tent for covering the opening when men are at work in the manhole and the need of a guard to prevent teams from accidentally driving into the tent. Second, it keeps the manhole dry in all kinds of weather and provides a convenient ladder so that any inspector can enter the underground chamber without stopping to change his clothes and without a helper to open the manhole for him.

Commercial Practice—Management, Rates, New Business.

Delivering Electric Meters.

The New York Edison Company has lately made several improvements in its system of handling meters that are doing much toward eliminating the chance of injury to meters between the time when they leave the laboratory in perfect condition and installation.

The baker's pie wagon was responsible for the change. Formerly a number of meters were put into a large box and these boxes piled up in the meter wagons. The only safeguard provided against rattling and banging was a mat on the floor of the wagon, which, by the time several boxes of meters had been piled upon it, lost all its resilience.

The ultimate outcome was the placing into service of six new electric vehicles with a capacity of 3,000 pounds each, designed after the pie wagon, with racks running along the sides for holding the meters, and an alleyway from front to back. The compartments are of various sizes to accommodate the different kinds of meters, each wagon carrying forty-two. Every compartment is fitted with a cushion which covers the floor and part of the walls and drops over the sill, so that once a meter has been set inside it is practically safe and secure. These six new vehicles are especially equipped for this kind of work. They are Lansdens, Detroits and Walkers. Each one has a carrying capacity of 3,000 pounds.

The island of Manhattan is divided into three distribution districts for the convenience of the company. Formerly there was a meter storehouse in each district and all meters wanted either up or down town were transported from the main storehouse, at 117 West Thirty-ninth Street, to the district storehouse, and thence to their final destination.

In revising the system, the branch storehouses were abolished. All records are now kept at the main storehouse, which has a capacity for holding 20,000 meters, and all meters are taken from here directly to "the point of use." For transporting them, the electric wagons with the cushioned compartments are employed. The wagons are loaded late in the afternoon and start out the following morning, delivering directly to the different jobs ahead of the wiring crew.

A meter leaves the storehouse in perfect condition, is inspected three days after it is set up, and at the end of the month undergoes a complete test. A great improvement of meters at the time of the first month's test has been recorded since the adoption of the new sytem.

Mississippi River Power Company Progress.

The Mississippi River Power Company has issued a calendar for 1912 bearing a large and well executed lithograph showing two aborigines paddling on the Mississippi in a birch-bark canoe and gazing in wonder at the completed dam and power house which the company is erecting near Keokuk, Iowa. The poster depicts an extensive city of sky-scrapers upon the bank. A second and smaller lithograph gives a bird's-eye view of the development. A description of this plant, which is to develop 200,000 horsepower from the water of the Mississippi River, is given under the calendar pad. The company has also issued Bulletin No. 4 showing progress.

Philadelphia Street-Lighting Contract.

There was but one bidder for the street-lighting contract of Philadelphia for 1912, and that was the Philadelphia Electric Company, which has been supplying current for this purpose for years. The price proposed was twenty-seven cents a night. It is expected that 936 additional street lamps will be added next year, making a total of 14,038 lamps to be operated. The price of twenty-seven cents applies to those lamps which are supplied by cables laid in city-owned conduits. Where the lamps are supplied by cables laid in conduits owned by the company the quotation is twenty-nine cents per lamp per night. The contract for 1911 amounted to $1,238,923.

Electric Christmas Shopping.

Following inquiries from two or three of our readers as to the best class of electrical material to stock for the Christmas trade, the question has been raised whether the central stations in general and the retail dealers pay sufficient attention to the distribution of electrical matter at the Christmas season. There is no disputing the fact that a lot of good money is spent at Christmas and New Year's on small priced articles ranging (say) from $1 to $25. This being so, there does not seem to be any reason why electrical apparatus should not occupy a relatively more important place among Christmas and New Year presents. There is more than one reason why this should be the case. To begin with, the majority of low-priced electrical apparatus is far more useful than the average gift. Added to this is the fact that the electrical gift is generally well constructed and designed to last for a number of years, as compared with flimsy temporary articles of other kinds. Last, and perhaps not least from the central-station viewpoint, is the fact that they consume current not only at Christmas time but, if they are used, all the year round, and so become a continuous source of revenue. We believe that the sale of electrical apparatus at this time of the year has not been so vigorously advanced as it might well have been, and that purchasers have not had the advantages of electrical toys, novelties, luxuries and so on sufficiently clearly placed before them.

It is unnecessary here to repeat the numerous utilitarian articles that are to be found on many of the counters of electrical retail houses, but two or three things of special interest have been brought to our notice recently. One of these is a type of present, dear to the heart of every school boy, consisting of passenger cars, locomotives, freight cars, etc., all motor-driven. Another one equally calculated to give pleasure at this joyous season is a small projection lantern which can be purchased for a few dollars and will repro-

duce on a small screen images of postcards or books or any other article that it may be desired to enlarge. These are only two examples, but they point the moral that in the present age there are numerous electric toys which are not only as attractive as the old-fashioned mechanical toy, but have the added value that they are permanent, enjoyable and intensely instructive in their operation.—*Electrical News.*

Electric Refrigeration in Rochester.

Rochester is far ahead of any other city in the country in the matter of electric refrigeration, a recent report compiled by the Rochester (N. Y.) Railway & Light Company showing that the equivalent of two tons of ice a day is made per 1,000 inhabitants.

The company has recently published an attractive booklet entitled, "Your Ice Box," which is devoted to the economy, conveniences and advantages of electric refrigeration. Some of the points brought out are that electric refrigeration is colder than ice, steadier, drier, cleaner, more compact, more reliable, more convenient, more flexible and cheaper than ice. With a properly installed plant, the production of one ton of refrigeration does not require more than thirty kilowatt-hours of energy and, under favorable conditions, considerably less. Figuring energy, even at four cents per kilowatt-hour, the total cost of operation per ton, including water for cooling ammonia condenser, oil, cleaning material, supplies, etc., is less than $1.39.

How Rockford Company Uses Old Arc Lamps.

When the old direct-current arc lamps were removed from the circuits of the Rockford (Ill.) Electric Company they were stored in the warehouse of the company pending ultimate "junking." Recently an ingenious scheme has been adopted for utilizing these lamps.

At a cost to the company of fifty cents they are fitted with an incandescent-lamp socket and equipped with a high-candlepower tungsten-filament lamp. These converted fixtures are then loaned free of charge to commercial lighting customers.

The company states that the lamps are of pleasing appearance, give efficient light and have been an excellent means of meeting the competition of the local gas company.

Proposed Transmission Line to Connect Cannon Falls Dam and the Rapidan Hydroelectric Station.

It has been decided by the Consumers Power Company, of Minnesota, to construct a high-tension transmission line between Cannon Falls dam and the Rapidan hydroelectric station and serve the towns and intervening territory with power and light. The population along this line is approximately 10,000, the towns being Eagle Lake, Janesville, Waseca, Waterville, Morristown, and Warsaw.

A ten-year contract has been entered into with the city of Waseca, Minn., by the Consumers Power Company, under which the latter will furnish current to the switchboard of the municipality, the current to be sold and distributed by the city. A twenty-five-year franchise, ten-year water-pumping contract and a ten-year street-lighting contract have been secured in Janesville, Waterville and Morristown.

The new business department has been at work in the various localities and sufficient business to warrant the extension has been secured. In additional to being a profitable investment this extension will give the company the additional advantage of having the two power stations connected.

Fairbury to Have White Way.

As a result of agitation by the Commercial Club of Fairbury, Neb., the town is to have a "great white way." Ornamental posts twelve feet high and each containing five tungsten lamps will be used. Twenty-four of these posts will be placed around the village square and the adjacent blocks of other streets will be similarly equipped.

Massachusetts Municipal Plant Reduces Rates.

A considerable reduction has been made by the Reading (Mass.) Municipal Light Board in its rate for lighting and also for electric cooking. The new rate for Reading will be twelve cents per kilowatt-hour for lighting and four cents per hour for heating and cooking purposes. The new rates will take effect on January 1, 1912. The old rates were fifteen cents an hour for lighting and six cents an hour for cooking or heating purposes. There is a provision by which the minimum charge of consumption for lighting will be $1.00 per month, except during the months of May, June, July and August, when the minimum charge will be reduced to fifty cents.

New rates are also announced by the plant for its patrons in Lynnfield Center and North Reading, both of which towns are supplied with electricity by the Reading municipal plant. These towns benefit by a twenty-five per cent reduction. The new rate for lighting is fifteen cents an hour, and for cooking or heating a rate of four cents an hour is made.

New Haven Company Leases Properties.

The New York, New Haven & Hartford Railroad Company, acting with the controlled Connecticut (trolley) Company and the Housatonic Power Company, has leased to the United Electric Light & Power Company all the large electric and gas companies which were acquired by it some years ago.

This sub-lease covers all properties except those used for railway purposes in the towns of Waterbury, Naugatuck, Watertown and Cheshire, "not including power stations or substations used wholly or in part for railway purposes," also the same class of properties in Norwalk, Wilton, New Canaan and Greenwich.

The lease made to the United Electric Light and Water Company runs 994 years and calls for the payment by the lessee of $365,000 a year in monthly pro rata amounts.

Byllesby Company Acquires New Property.

H. M. Byllesby & Company, Chicago, has purchased and taken over for operation the property of the Colorado Light & Power Company. A new company, the Arkansas Valley Railway, Light & Power Company has been formed, which company will operate all of the properties formerly operated by the Colorado Light & Power Company and the Pueblo & Suburban Traction & Lighting Company. The Colorado Company formerly operated in Canon City and Cripple Creek, the latter being in the midst of the gold-mining district where a large amount of electric power is used in the mines. The total population of the two towns is over 14,000.

Electric Lighting and Illuminating Engineering

THE VALUE OF PHOTOGRAPHY IN ILLUMINATING ENGINEERING.

SECURING TRUE PICTURES OF THE ACTUAL ILLUMINATION.

The question of taking good photographs of artificially lighted interiors is now receiving much attention among illuminating engineers and some experiments described by J. S. Dow and V. H. Mackinney in a paper before the Royal Photographic Society of London this year, and also in the *Illuminating Engineer*[1] (London), may be of interest.

It is hardly necessary to point out that skillful photography of this kind is a very useful asset to any company engaged in selling light or lighting appliances. A good photograph of an exceptionally successful installation will convince people and induce them to adopt a system of illumination when the most persuasive conversation might fail. It is, however, essential that the photographs should answer their purpose of representing *exactly* what the conditions of illumination are like. In the case of many photographs taken by artificial light the results are not such as to commend the installation. Very often the distribution of light appears quite different from what it really is, while the actual sources of light are often lost in a cloud due to "halation" which suggests to the observer that this is a very glaring installation indeed!

The object of a skillful photographer is twofold. He wishes the photograph to give a good impression of the distribution of light and to show objects just as they appear when illuminated by the artificial means, and he also wishes to bring out the appearance of the actual sources themselves. The artistic appearance of rooms when artificially lighted is often dependent quite as much on the appearance of the lamps, shades and fixtures as on the illumination produced and for the sake of information it is obvious that a photograph should show these correctly and not allow the outlines and appearance of the lamps to be hopelessly lost in a confused blur.

For scientific purposes (for presentation before a society dealing with illumination, for example), the operator is still more restricted. To be really valuable the photographs should often be taken exclusively by artificial light, and for scientific comparison it is often also essential that there should be no retouching of the photograph; it may be added, however, that in the case of such views as these it is usually a difficult operation to do much retouching without traces of the operation being clearly seen.

Now the delicacy of the light and shade in a photograph is admittedly extremely dependent on correct exposure. Yet, in the case of artificially lighted

FIG. 1.—COMPARATIVE ILLUMINATION FROM BARE TUNGSTEN LAMP AND SIMILAR LAMP WITH REFLECTOR.

interiors, it is very difficult to judge by the eye alone what the exposure should be. The eye is readily deceived as to the relative brightness of various objects and the ordinary actinometers, based on the darkening of sensitive paper when exposed to light, cannot be used in the case of artificial light; owing to the relatively low actinic power of the light as compared with daylight, and also the much lower order of brightness prevailing, it would often take hours, or possibly days, before any appreciable indication could be obtained.

Messrs. Dow and Mackinney have therefore adopted the method of basing the exposure on photometric readings. For this purpose a little apparatus termed the Holophane Lumeter, which is a more perfect form of the instrument previously described in these columns[2] is made use of. This enables the surface-brightness of any object to be rapidly and easily observed. The brightness of the chief objects of interest in the view are studied and, by experience, the best exposure can be readily ascertained.

Apart from the ease with which these measurements can be made, it will be observed that this is a more perfect method of studying the subject to be photographed than any general measurement with an exposure-meter. In an artificially lighted interior we are faced by the difficulty that the range of brightness of the different objects, such as illuminated walls, ceilings, table-cloths, lamps and lamp-shades, is sometimes far greater than a photographic print could readily convey. One has therefore to study the room carefully and decide which tones it is most important to represent correctly.

As an illustration of the extraordinary variety of tone that may be met with in practice the following table has been compiled:

Nature of Surface.	Equivalent Surface-Brightness in Foot-candles. (Very approximate.)
Sun at zenith	860,000,000
Electric arc light (crater)	7,600,000
Electric metallic filament	400,000
Incandescent mantle	15,000
White surface, illuminated by direct sunlight in summer	6,000
White sky (average)	2,000
Candle flame	1,000
Dark buildings, tree-trunks, etc., illuminated by diffused daylight	500 to 50
Diffusing shades over artificial sources of light	500 to 50
White objects in brightly lighted shop windows	50 to 10
Page of book illuminated by artificial light (good reading illumination)	5 to 3
Wall-papers and ceilings in artificially lighted interiors	1 to 0.1
Dark portions of churches, deep shadow, etc.	0.5 to zero

When it is remembered that the greatest variation in depth in the photographic print is about 30 to 1, it will readily be seen that it is impossible to get the gradation of tone of all parts of a subject correctly; one must therefore adjust the exposure for the particular purpose in view and sacrifice other parts. If, for example, one selected the exposure that was ideal to bring out the shining prisms of a Holophane reflector, one would necessarily get an incorrect distribution of illumination below it since the order of brightness of

1 *The Illuminating Engineer*, London, September, 1911, page 529.

2 ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, July 16, 1910, page 129.

the illuminated surfaces is much less than that of the actual illuminant. As an illustration of this point three photographs were reproduced in the paper before the Royal Photographic Society, all of them being developed in exactly the same way but having the exposure varied. The subject photographed was a booth in which the illumination of a lamp plus Holophane reflector and of a bare lamp were shown side by side. It was pointed out that the most important thing here was to get the relative brightness of the illuminated surfaces below the respective units exactly right The exposure which enabled this to be

FIG. 2.—INDIRECT ILLUMINATION OF A SCULPTOR'S STUDIO.

done necessarily allowed some parts of the black-painted woodwork to sink into obscurity, while, unless special precautions are taken, the actual lamps are over-exposed so that their outlines are not clearly seen. However, by blocking the actual sources out during the main exposure and then giving an additional very brief one, with both units fully exposed to view, this difficulty could be got over largely.

The case mentioned is a striking example of the necessity for the operator having both the requisite skill in photography and a perception of the results which are desirable from the illuminating-engineering standpoint. A professional photographer who was not an illuminating engineer might have obtained a photograph which made an equally good picture, but he would also have very likely failed to reproduce the exact relative brightness in tone which it was the whole object of the photograph to display.

The ideal results in this respect are shown in Fig. 1. As explained, an additional brief exposure was needed to bring out the lamp and Holophane reflector.

As another illustration of the value of photography in studying problems of illumination, mention may be made of some experiments recently published[3] by Justus Eck, of the Union Electric Company, who has made a special study of photography by the aid of the Holophane Lumeter. The object in this case was to prove that inverted arc lighting is not "shadowless," as has sometimes been suggested. In the course of a controversy on this matter the suggestion had been made that, if a white sphere and a corresponding white disk were hung up side by side in a room lighted by inverted arcs, both would appear equally bright all over because there would not be a proper shadow on the sphere.

Mr. Eck, however, actually tried the experiment, a photograph of the room being taken by the aid of the Holophane Lumeter supplemented by actual readings of the surface-brightness of the disk and sphere. The photometric readings were put forward to show that the conditions of light and shade were not very dissimilar to those characteristic of ordinary daylight and the photograph of the studio where the test was made, which is reproduced in Fig. 2, showed most conclusively that there is a well defined shadow on the sphere and excellent light and shade effects on the statue beneath it.

This method of attacking problems, the combination of accurate photographs and photometric readings, is admirable for providing a record of conditions of illumination. The photographs record the exact distribution of light, the photometer readings its intensity. It need

FIG. 3.—CABINS RESTAURANT, LONDON.

hardly be said that to obtain this gradation of light and shade so exactly is something of a triumph in photography. Mr. Ritchie, of the Union Electric Company, who has paid special attention to this kind of work, was among the first to judge exposure by studying surface-brightness with a photometric instrument and it may be doubted if such results could be obtained by any other means.

Another matter that may be touched upon here is the influence of the actinic power of the light. Granted that the brightness of an object lighted by different illuminants appears the same by a photometric instrument, may it not be possible that allowance ought to be made for the *quality* of the light? It is true that daylight differs considerably in this

[3] *The Electrician*, London, June 23 and July 7, 1911. *The Illuminating Engineer*, London, August, 1911, page 457, and October, 1911, page 593.

respect from many artificial illuminants. Yet the artificial illuminants met with in practice differ less than might be supposed. However, if ordinary plates are used, it is desirable to introduce a factor in calculating the exposure to allow for the actinic value of the particular illuminant. A little experience enables this to be easily done.

One other matter which of course affects photographs by any illuminant is the color of the objects illuminated. An ordinary photographic plate, for example, tends to cause red objects to appear dark in hue while blue objects are inclined to be reproduced too light. It is, however, well known to photographers that these difficulties can be completely got over by the use of special Wratten panchromatic plates which, in conjunction with a suitable light filter, reproduce colored objects exactly as the eye sees them. Recent researches have also shown that the use of these special plates eliminates any difference in the relative actinic value and color of different illuminants (with the possible exception of the mercury-vapor lamps). In any case, if the exposure is correct, a result exactly similar to that seen by the eye appears to be obtained.

Experiments have also been made with the Lumière color plates. It would obviously be an added assistance to the illuminating engineer if photographs could be secured which not only showed the distribution of light and gradation of tone exactly but also the true color of objects. In the case of artistic rooms with fancy walls, gilded ceilings and tasteful colored shades this would be very desirable. At present, however, there appear to be difficulties in the way of getting scientifically exact reproduction of colors, especially in the case of artificial illuminants, and the treatment and exposure of these plates requires considerable technical skill. It is possible to secure an attractive and pretty picture but it appears doubtful as yet if one could rely on the method for the production of exact scientific comparisons.

A few examples are given of photographs taken by this method. Fig. 3 shows the method of illumination recently adopted in the Cabins Restaurant in London, where Holophane reflectors covered by crimson silk shades are employed. (The white appearance of the windows is due to the fact that light was streaming in from a flame arc outside.) Fig. 4 shows the unique method of illumination employed at Gatti's Restaurant in the Strand, London, where inverted fixtures using high-candlepower tungsten lamps and crimson silk shades are employed. Their light is thrown up to a gilded ceiling producing a very mellow and artistic result and the exposure was selected mainly with a view to bringing out this effect.

It may be noted that in all these illustrations the blurring of the image of the sources of light has been very successfully avoided and that the very varied time of exposure shows within what wide limits this method can be applied. For example, in the case of the Cabins Restaurant (Fig. 3), the exposure was only four minutes, while in other cases the exposure may be as much as one hour.

In securing this absence of halation special methods, such as the use of very heavy backing on the plates, are employed but the most important factor is correct judgment of the exposure. The little instrument referred to has been already used to a great extent by several firms in London for taking photographs of lighting installations (notably Holophane, Limited, and the Union Electric Company, Limited).

In conclusion it may be repeated that the taking of successful photographs by artificial light is an important matter to firms that deal with lighting problems and it may be anticipated that as time goes on more companies will make a specialty of this work.

FIG. 4.—GATTI'S RESTAURANT, LONDON.

Electricity in New Zealand.

The demand for electricity in New Zealand for industrial purposes, such as for factories, mining, tramways, street lighting, and for domestic lighting, heating, and cooking, is increasing constantly. The public has become so educated to electricity that the need for its cheap development by water power is well recognized by local government authorities who now feel that unless they are prepared to permit private capital to establish water-power plants, they can no longer refrain from committing themselves to the necessary expenditure of capital and to the risks involved.

Already, according to the American consul on special service in New Zealand, 1,320,000 units of electricity are sold annually for electric lighting in Wellington, 742,000 in Dunedin, and 369,620 units in Christchurch. In Auckland electric lighting has just been introduced. In all these cities, except Dunedin, electricity is now produced from coal. Electric street lighting is already fairly well developed in Wellington and Dunedin, 562,000 units being used last year in Wellington and 102,000 units in Dunedin. The consumption is increasing and a bright future for the industry is assured.

Industrial Power

EUROPEAN EXPLOSION-PROOF MOTORS FOR MINES.

BY E. W. JANSEN.

Special types of motors are now being built in Europe to meet conditions encountered in mines. Such motors are designed for use within mines where there is a possibility of meeting dangerous gases such as weather-damp, and are built to meet the requirement imposed by law, which is that there shall be no possibility of causing an explosion, due to their operation.

This condition of explosion-proof construction does not necessitate that dangerous gases shall be excluded from the inner part of the motors themselves. Such a stipulation could not be fulfilled as, due to the bearings, the atmosphere cannot absolutely be excluded from the interior of the motors, even with those of the fully inclosed type. All that is desired is that an explosion within the motor itself can under no circumstances be extended to the surrounding air.

Of great importance for the manner in which these types of motor are now being built, were the trials made in the mining district on the trial ground at Gelsenkirchen-Birmark in the years 1903 to 1905. These were made in consequence of an agitation on the part of the Mining Institute at Oberbergsamtsbezirk Dortmund of the Westfaelischen Bergwerkschaftskasse in connection with a group of electrical manufacturers, under the direction of Bergassessor Beyling.[1] The conclusions drawn by these trials showed that there were two ways of meeting the requirement imposed, and both ways have been followed with success.

One manner of meeting the conditions is to build a fully inclosed motor, the frame and end shields of which are so strongly dimensioned that the motor will not fly apart when subjected to the high pressure of an explosion within. Fig. 1 shows a motor of this type.

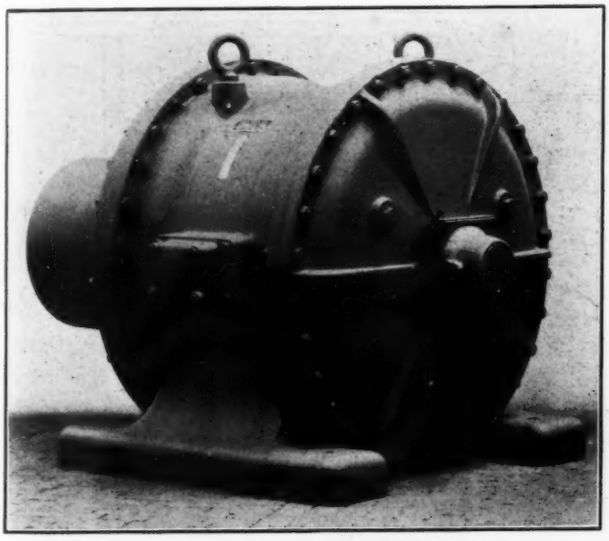


FIG. 1.—FULLY INCLOSED MOTOR.

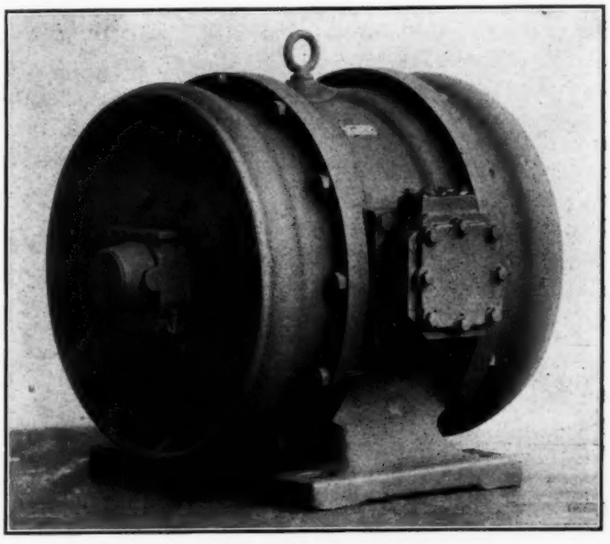


FIG. 2.—SEMI-INCLOSED MOTOR.

The second type of construction, which meets the conditions imposed, is that of the semi-inclosed type; one such that when an explosion takes place within the motor the gases are so far cooled before they reach the outer air that they will not ignite the surrounding atmosphere. For this purpose the frame of the motor is fitted with a so-called "ring-type screen" (in German Plattenschutz) which is composed of numerous annular rings stamped out of fine sheet metal fitted in a frame with an air space of one-half millimeter between them. A ring of this type is shown in Fig. 3. The exploded gases from the interior of the motor reach the surrounding air through the radial spaces left between the iron sheets, but due to the great cooling surface of the protection screen, they are so far cooled that they do not ignite the air on the outside. The principle is essentially the same as that of the Davy safety lamp. Fig. 4 shows schematic longitudinal section of such a motor and Fig. 2 illustrates a motor of this type as put upon the market.

Still another type found in practice is that shown in Fig. 5. Here the ring-type screen is only constructed around the parts of the motor which, in normal course of operation, could generate the spark for igniting the weather-damp, such as an alternating-current motor of the induction type with phase-wound rotors. The rest of the motor, *i. e.*, besides the slip rings, is executed in the normal ventilated type of construction, the atmosphere having unhindered admittance.

As above mentioned, trials show that the ring-type screen must be constructed with the greatest care, as its effi-

1 For reference see Vol. I to XIII of *Glueckauf*, 1906.

ciency is nullified by even the slightest variation of space between two of the rings composing it. The safety of the motor, as shown in Fig. 1, also disappears if the end shields, or motor frame, possesses any casting failures. It is therefore very essential that the finished motors, for use in places where weather-damp is prevalent, are tested in the most careful manner as to their efficiency with respect to safety, before delivery.

One of the European electric motor manufacturers, the Siemens-Schuckertwerke, of Berlin, Germany, whose motors have been used as an example and for illustrations of this article, have constructed a special testing station at their Nuremberg factory. This station is shown in Fig. 6.

A specially made cabinet of heavy beams incased in sheet-iron armoring, is situated in the center of a walled-off space in a yard adjoining the factory. On two opposite sides of the cabinet are doors securely bolted to the rest of the framework. These parts are built like frames into which are stretched sheets of oiled paper, making the interior gas-tight. After mounting motor and connecting up the leads, the cabinet is closed and filled with a mixture of air and dangerous gases, representing actual conditions in a mine. Care is taken that the mixture of gas is distributed evenly throughout the interior and that it also reaches the interior of the motor. While the motor is running, the gas mixture within the motor casting is artificially exploded by an electric spark from the outside of the cabinet. With correct construction of the ring screen or perfect casting, as the case may be, according to the type being tested, the explosion is not transmitted to the mixture within the cabinet. The test is made twenty to thirty times with varying conditions of the dangerous gases. Only when the motor has withstood all tests, is it forwarded from the works as an explosion-proof motor.

If the motor should show a defect and ignite the surrounding air within the cabinet, the paper walls in the sides forming the doors act as safety valves and prevent damage.

Besides the motors, the same company has put upon the market a line of accessory apparatus, such as controllers, starters, switch-cases, lightning transformers, switches, etc., which are also classed as explosion-proof. With the first four mentioned types of apparatus, the principle of submerging all current-carrying parts under oil is employed, the covers of such parts being so interlocked that they cannot be opened without first throwing off the current.

In the protected types of switch-cases and transformers, the construction is so designed that the necessary fuses are inclosed with the apparatus and also submerged in oil, so that if, for any cause, a fuse should blow out, the spark does not even reach the atmosphere within the casing. In Germany, particularly, laws have been passed limiting high-tension installations in mines to 3,000 volts, for which reason all motors and other electrical apparatus are built for this maximum tension.

FIG. 3.—RING SCREEN.

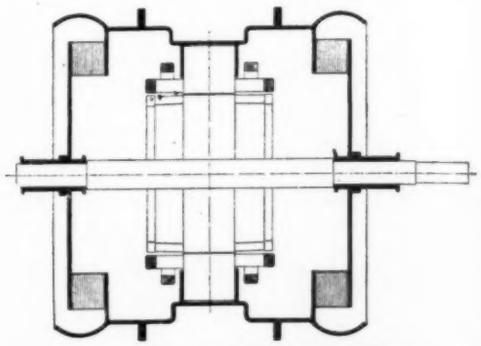


FIG. 4.—SECTION OF MOTOR.

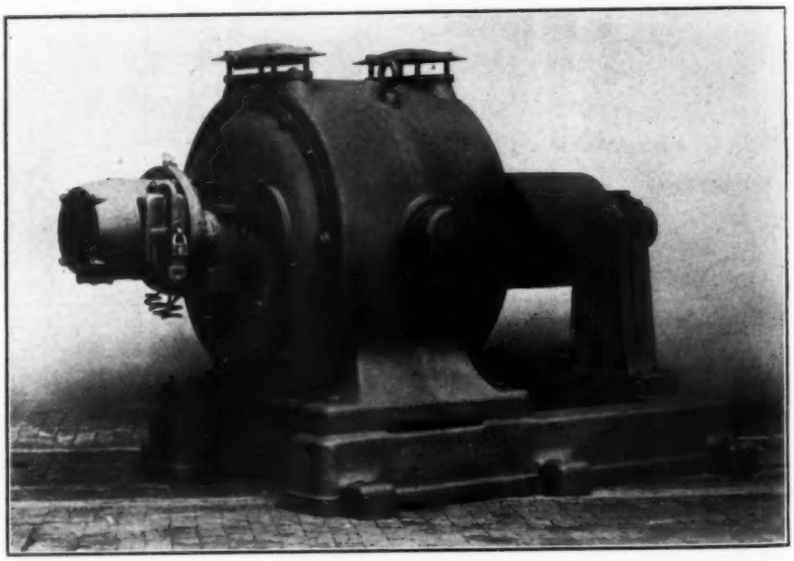


FIG. 5.—EXPLOSION-PROOF MOTOR.

Longest Railway Tunnel to be Electrified.

What is said will be the longest tunnel in the world is proposed for construction through the Caucasus Mountains, near Vladikaukaz, Russia, according to the *Engineer* of London. It will be thirteen miles long and is to be completed in seven or eight years at an estimated cost of 100 million rubles. A double railway track is to be laid through it. The mountain rivers in the neighborhood will furnish 13,500 horsepower, which is to be converted into electric energy. A meeting of engineers connected with the Simplon and other well-known European tunnels was recently held to discuss the projected construction.

Electrification of Prussian Suburban Lines.

It is reported that the Prussian State Railways are planning to electrify the suburban service in and about Berlin with single-phase locomotives despite the successful operation of single-phase

motor cars on the Blankenese-Hamburg Ohlsdorf lines. This decision is not only due to the fact that the present steam trail cars must be used, but also on account of the lower cost of maintaining one large engine as compared with eight to ten motor cars.

A Tungsten Resistance Furnace.

Franz Fischer and E. Tiede described, in a recent meeting of the Deutsche Chemische Gesellschaft a resistance furnace consisting of a tube of tungsten, made according to Wartenberg's process. The tube has a length of 8 centimeters, a diameter of 1.6 centimeter, and a wall thickness of 3 millimeters, and it can take currents of 3,000 watts in a vacuum. It fits at its two ends into the electrodes, two rods of copper, which are fitted with cooling-pipes. The rods and the tube form the horizontal diameter of a glass globe, which is kept wetted with water. A greased rubber tube leads over to the air pump. The cooling of the electrodes is so effective that a good vacuum can be maintained. A small magnesia crucible can be placed in a hole drilled into the tungsten tube.

FIG. 6.—TESTING STATION FOR EXPLOSION-PROOF MOTORS.

An Electric Sanding Machine.

The accompanying illustration shows an electricalley driven sanding machine about the size of an ordinary lawn mower, upon which is set a two-horsepower direct or alternating-current motor.

It is claimed that any mechanic of ordinary intelligence, without any skill in any particular line, can run the machine, doing perfect work in surfacing off a floor without injuring it. One operator can do the work of ten skilled mechanics and with this device can earn from $20 to $50 per day.

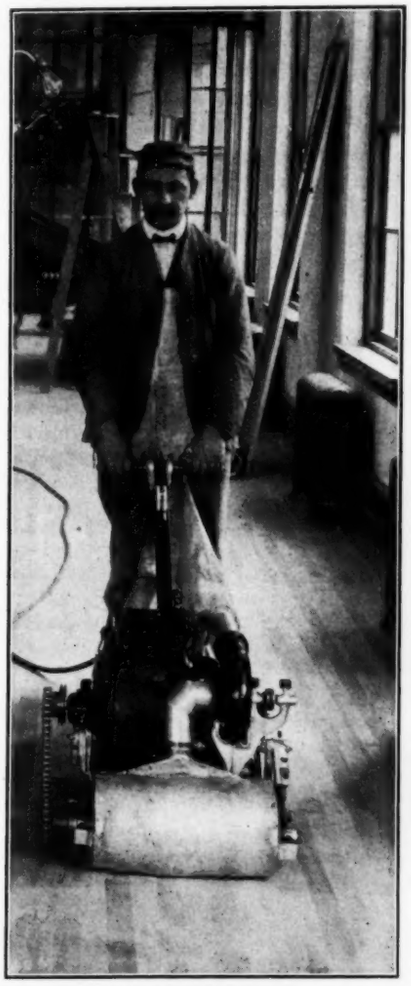
It is maintained that the machine is easier to handle than a lawn mower, as it propels itself and all one has to do is to guide it and not even push it. The work is under complete control and produces the finest workmanship. It is possible to cut down any wood-floor surface with the use of Number 3½ garnet sandpaper whether painted, varnished or waxed and one can surface them to a smooth finish by the use of Number 0 on this same machine.

It is pointed out that this flexible floor-sander, being propelled automatically, produces a uniform and even surface in the shortest time and with the least labor possible; when properly adjusted it produces a deep cut and finally smoothes to a perfect finish.

By using electric power it requires only a turn of the motor lever, a guiding hand and a watchful eye, and an intelligent boy can operate it and do the work of a dozen men.

This electric floor sander was designed for work in the finest homes and institutes as well as large office buildings and stores. All dust is drawn by suction and deposited in a bag, causing no injury to draperies and furniture or annoyance to persons nearby. The machine travels at the rate of twenty-five feet per minute and is under absolute control of the operator. A touch of a finger will change its course or depth of cut. A controlling handle in the rear, raises and lowers the surfacing roll and also guides the machine; the flexible arms permit the abrader to follow the inclination of the floor, smoothing the surface.

It is stated that as a floor-polishing machine for use in ball rooms, hotels and public buildings it is invaluable, doing the work of a large force of men. For this work a polishing brush is inserted in place of the sanding roll.



SANDING MACHINE.

In operation the abrading cylinder is covered with sandpaper which requires only a few seconds to change. Coarse paper is used for roughing off and finer paper for final finish, each sheet lasting about half an hour. The paper is clamped firmly by jaws which constantly keep it taut and even.

Questions and Answers

All readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN are invited to submit questions and answers to this department. Correspondents are requested to send full name and address. This, however, will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered.

Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question. Answers will be published in a subsequent issue.

QUESTIONS.

No. 13.—AUTOMOBILE IGNITION SPARK COIL.—Please give sketch and information on a low-tension spark coil to be used in connection with the make-and-break ignition system of a six-cylinder automobile, to be operated on six volts.—S. L. K., Reading, Pa.

No. 26.—ELECTROLYTIC RECTIFIER.—Please describe and give sizes of the simplest form of electrolytic rectifier consisting of aluminum and lead plates in ammonium phosphate solution, to be used for charging (at least two at a time) automobile ignition batteries on 110-volt alternating-current circuit.—J. S., Alameda, Cal.

No. 31.—ELECTROMAGNETIC SWITCH.—I want to make an automatic switch to take the place of a double-pole, double-throw switch. Its upper contacts are to connect to a 110-volt dynamo and the lower contacts to a 110-volt storage battery. It must be arranged so that a coil across the dynamo circuit holds the armature to the dynamo contacts and that when the dynamo current is off the armature drops by gravity and thus lights the lamp circuit from the battery. When the dynamo starts up again the reverse operation must take place. Please give design of such a switch. What size and number of turns of wire must be put on the coil to give the armature sufficient travel and lifting power? What must be the size of the armature and core? Could the coil be connected directly across 110 volts without a lamp in series?—C. A. J., Minneapolis, Minn.

No. 36.—WAVES OF MAGNETIC INDUCTION AND ELECTROMOTIVE FORCE.—If I am given the shape of the electromotive-force wave of a certain alternator, expressed in terms of a sine series, and am required to find the shape of the wave of magnetic induction that the given electromotive force will produce in the iron core of a static transformer, the constants of which are known (including the hysteresis loss for any range), how shall I proceed? I understand that I can find the induced electromotive force in the secondary by differentiating the equation of the flux, but the several treatises which I have consulted fail to show me conclusively how the wave of magnetic induction is obtained from the applied electromotive force when this applied electromotive force is not sinusoidal.—M. S., Atlanta, Ga.

No. 37.—TIME SWITCH FOR STREET-LIGHTING CIRCUITS.—Can a time switch mounted in a box on a pole be depended on to close and open a remote circuit for ornamental street-lighting that is supplied in multiple from the regular 110-volt mains?—H. W., Battle Creek, Mich.

No. 38.—WOUND ROTOR FOR INDUCTION MOTOR.—How is the rotor of a three-phase induction motor wound so as to have only two slip rings? I recently saw one whose speed can be regulated by changing grid resistances in series with the rotor, but it had only two slip rings, whereas I think it should require three.—D. T., Highland Park, Ill.

ANSWERS.

No. 33.—ELECTROPLATING BRASS.—Can brass be electroplated on cast iron? If so, what solution is used and what strength of current?—H. M. C., Little Rock, Ark.

Brass can be electroplated, but it requires a great deal of experience and careful attention to details. A large number of solutions have been used, these varying chiefly as to the kind of brass it is desired to deposit. Slight variations in the making of the solution, in the strength of current or in the temperature of the bath will produce differently colored brass, or deposit almost entirely only one of the constituent metals, copper or zinc. The following is a typical solution: water, 3,200 parts; copper chloride, 16 parts; zinc sulphate, 32; potassium carbonate, 400; ammonium nitrate, 200. Dissolve each salt separately, then mix the first three solutions and add the nitrate solution last. The articles to be plated must be perfectly clean. The anodes should be of good sheet brass of about the color of that desired. Regulation of the current depends on the color desired and must be done by experience; too strong a current deposits an excess of zinc; too low a current produces a reddish brass from an excess of copper. High temperature produces a similar effect to an excess of current.—G. B.

No. 34.—ALUMINUM-CELL LIGHTNING ARRESTER.—Can aluminum-cell lightning arresters be installed outside the station where the coldest winter weather is around zero Fahrenheit? At what temperature are they liable to freeze up?—N. R., Knoxville, Tenn.

Aluminum-cell lighting arresters have been frequently installed outside stations where they are exposed to temperatures of twenty degrees below zero and still lower. The electrolyte may freeze up solid without making the arrester less effective and without injury to it. This liquid freezes at a considerably lower temperature than water. If heavy sleet storms prevail, the horn gaps installed with the aluminum-cell arrester should be protected by some sort of a roof.—W. E. M.

No. 35.—FLAME LAMPS ON FLUCTUATING VOLTAGE.—Which kind of arc lamp burns more steadily where the voltage fluctuates five or even more per cent around normal, the magnetite arc or the flaming arc?—B. H. S., Youngstown, O.

If direct current is available, the magnetite arc lamp will be more suitable for this case, since it produces less flickering for voltage changes than the flaming arc. The latter requires better voltage regulation for steadiness of burning than the present circuit seems to have. No lamp will burn without flickering, however, on such a fluctuating voltage. If alternating current only is supplied and a flaming arc found to burn too unsteadily, an inclosed arc should be used, efficiency being sacrificed to the poor regulation. The best thing to do is to improve the regulation of the circuit as much as possible.—L. M.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

WESTERN UNION TELEGRAPH COMPANY.

The Western Union Telegraph Company has issued its preliminary estimated statement of earnings for the quarter ended December 31, 1911. They compare with the actual figures for the same period of 1910, as follows:

	1911	1910
Net revenue	$2,460,200	$1,760,809
Bond interest	434,200	433,063
Balance	$2,026,000	$1,327,746
Dividends	747,910	747,802
Surplus	$1,278,090	$579,944

Profit and loss surplus as of Dec. 31, 1911, partly estimated, $12,549,310.

The actual figures of the Western Union Telegraph Company for the quarter ended September 30, 1911 (approximate previously published), compare as follows:

	1911	1910
Net revenue	$2,338,936	1,941,066
Bond interest	434,165	433,062
Balance	$1,904,771	$1,508,004
Dividends	747,906	747,770
Surplus	$1,156,865	$760,234

The earnings, partly estimated, for the six months ended December 31, 1911, compare with the actual figures for the corresponding six months of last year as follows:

	1911	1910
Net revenue	$4,799,136	$3,701,875
Bond interest	868,365	866,125
Balance	$3,930,771	$2,835,750
Dividends	1,495,816	1,495,572
Surplus	$2,434,955	$1,340,178

BUFFALO GENERAL ELECTRIC.

The Buffalo General Electric Company reports for the ten months ended October 31, 1911, compared as follows:

	1911	1910
Operating revenue	$969,675	$867,526
Expenses and taxes	611,919	531,095
Income from operation	$357,756	$336,431
Other income	40,449	33,106
Total income	$398,206	$369,537
Interest	125,563	111,511
Surplus	$272,643	$258,026

Stone & Webster to Take Over Utah Company.

Negotiations are said to be pending for the sale of the Utah Light & Railway Company of Salt Lake City to Stone & Webster of Boston.

The Utah Light & Railway Company operates 111 miles of standard gauge track and 170 passenger cars. It is a consolidation of three light and power companies and has a blanket franchise running to 1955. Of the $2,062,000 common and $4,000,000 preferred stock outstanding, the Oregon Short Line is the owner of $1,850,000 common and $3,840,000 preferred.

Tacoma Home Company Sells.

The Home Telephone Company, operating in Tacoma and Bellingham, Wash., has been acquired at public auction by the Pacific Telephone & Telegraph Company, the only bidder, at a price of $550,000. The Home Company was incorporated for $5,000,000 and had outstanding issues of $1,600,000 bonds, held by the Title Insurance & Trust Company, Los Angeles, Cal., and par value stock to the extent of $1,500,000, held principally by Los Angeles interests.

On a basis of the purchase price the bondholders will receive twenty-eight cents on the dollar, with no reimbursement for the stockholders. The City of Tacoma, which had planned to purchase the plant and operate as a municipal property, was denied such action through provisions of the state law which does not permit the ownership of such property by a city. The Pacific company will make physical connection between its system and the one now acquired at once. A.

American Telephone Gains.

Despite business depression the American Telephone system will, for the year to end the last of this month, make a gain in stations of slightly over 600,000, compared with 740,027 in 1910 over 1909. Had the annexation of so-called "connecting stations," which are independent companies connected with the Bell system, been as rapid as last year, the gain in 1911 would have equaled that of 1910.

As it is, the American Telephone Company will have on December 31 a total of 6,500,000 stations, of which 4,500,000 will be Bell stations proper and 2,000,000 stations of connecting companies.

United Wireless Re-organization Proposed.

Steps are to be taken to re-organize the United Wireless Telegraph Company which recently got into financial difficulties.

It proposed, according to the call issued, to 33,000 stockholders, by Arthur P. West and others, to pay off debts amounting to $150,000 and to form a new corporation of the same name, issuing new stock dollar for dollar "to the present innocent bona fide stockholders." The amount of stock held by such stockholders is stated to be $2,000,000.

Holiday Traffic Heavy On New York Lines.

President Shonts, of the Interborough Rapid Transit Company, of New York City, stated that during last few days subway and elevated lines have been carrying record crowds. In a statement asking co-operation of the public with Interborough employees so that traffic crowds may be facilitated, Mr. Shonts said:

"On December 11, the elevated lines safely carried 1,019,166 passengers and operated a car mileage in excess of 194,000 car miles. On the same day, the subway lines safely carried 1,090,382 passengers and operated a car mileage in excess of 189,000 car miles.

"The subway figures before mentioned are an increase in passengers over the same Monday last year of 80,611 and an increase in car mileage run for the same day last year of 73,000 miles.

"On this day the subway carried more passengers than any other day in its history except during the Hudson-Fulton Celebration."

Pacific Gas & Electric Company Buys New Properties.

The Pacific Gas & Electric Company has purchased the Metropolitan Light & Power Company for a consideration said to be $2,000,000. The company assumes the bonded indebtedness of the Metropolitan Company for about $1,625,000 as part of the purchase price. The Pacific Company has also acquired the Mutual Electric Company of San Francisco, and its existing contract with the Board of State Harbor Commissioners. A.

Automatic Electric Sells British Rights.

The Automatic Electric Company is reported to have sold its telephone manufacturing rights in the British Isles to the United Insulated Wire Company, of Great Britain, for $500,000 in cash and stock amounting to about $600,000 in the British company. The cash is to be used in retiring Automatic Electric Company bonds.

Keokuk Companies Merge.

Public service corporations controlling the gas, street lighting and street railway of Keokuk have merged into one company under the name of the Keokuk Electric Company. The capital stock is $650,000.

New Electrical and Mechanical Apparatus and Appliances

The Westinghouse Equalizer-System Hoisting Set.

The Calumet and Arizona Mining Company has recently completed an elaborate set of tests on the electric hoisting system which has been in operation since the latter part of September, 1909, at its mine in Bisbee, Ariz. The installation has been highly satisfactory in every respect and everybody who has seen it remarks on the ease with which it is handled and the complete control which the operator has over it.

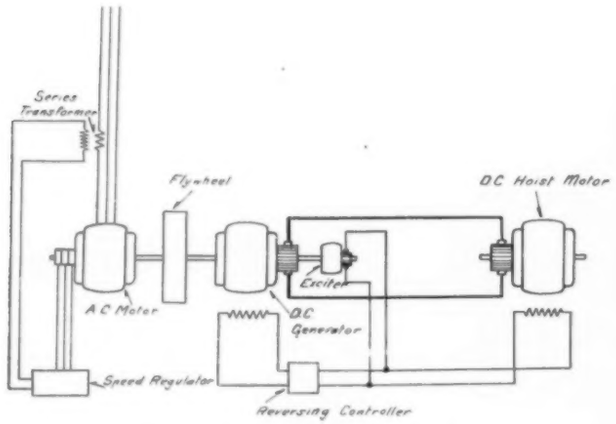


FIG. 1.—DIAGRAM OF HOISTING SET.

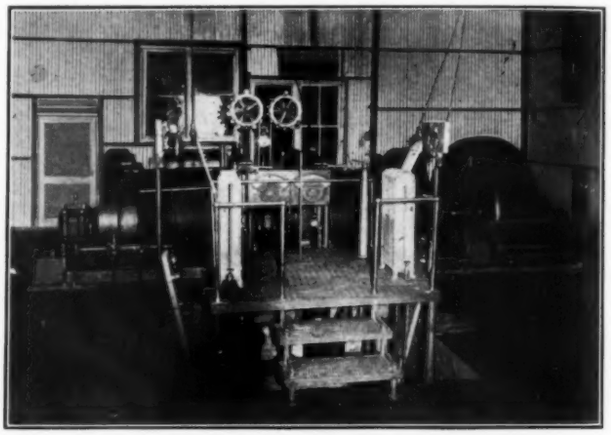


FIG. 2.—MINE HOISTING SET.

Tests have shown that, even under severe operating conditions, where the hoist is running a great portion of the time, the average input to the system over a day's run will not exceed more than about 20 or 25 per cent of the maximum load, and that the rate of input is practically constant.

The performance of the hoisting installation at Bisbee is only a repetition of what this system has done at the many mines now using it. The increased use of long-distance high-tension transmission lines has brought electric power to even the more remote mining districts. This had led to the installation of the sets here described in mines with almost all kinds of hoisting conditions.

With small hoists, it has been found satisfactory to use alternating-current induction motors directly applied, but where heavy loads are to be handled and at high speed, the peak due to the acceleration of the rapidly moving parts is always greatly in excess of the average requirements of the hoist. Now if the current is obtained from a line also carrying a lighting load, the resulting fluctuations of voltage prove most objectionable. Moreover, in most cases, the hoist is at the end of a long transmission line and so an excessive amount of copper must be installed to prevent drop in the voltage during maximum demand. The result is that the line must be equipped for peak instead of average load, at a greatly increased expense.

The above undesirable conditions have been overcome by the Westinghouse equalizer-system hoisting plant, the essentials of which are diagramatically shown in Fig. 1. It consists of a direct-current motor, direct-connected to the hoist drum, and a flywheel motor-generator set which includes a direct-current generator, a laminated flywheel, an alternating-current induction motor and an exciter. The equipment also includes a reversing controller for the generator field, a speed regulator, a series transformer, and a switchboard.

The hoist proper was built by the Denver Engineering Works and it has a normal duty of 6,000 pounds unbalanced load. Its speed is 1,000 feet per minute. The ultimate depth of the shaft is 1,200 feet.

The armature of the generator and the hoist motor are electrically connected direct. The field of each machine is excited separately, constant full field being maintained in the motor. The hoist is started by gradually increasing the field of the generator and so delivering a proportional voltage to the hoist motor. When the load on the alternating-current motor reaches a certain point, resistance is automatically applied to its secondary circuit, reducing the speed of the set and the energy stored in the flywheel is used to overcome the peak of the hoisting cycle. Thus there is a minimum use of current.

The hoist is stopped by gradually weakening the generator field and thus allowing all excess in the descending cage, the rotating hoist motor and the drums to be returned to the flywheel through the generator which momentarily acts as a motor, receiving energy from the hoist motor which for the moment acts as a generator.

The overall efficiencies of hoists of this type are generally from 50 to 60 per cent when operated under normal operating conditions.

Because of the ease of control and the general characteristics of the set, it is a simple matter to devise reliable safety devices which do not depend on mechanical brakes. Such devices have been put in practice in Germany, where the government allows men to be

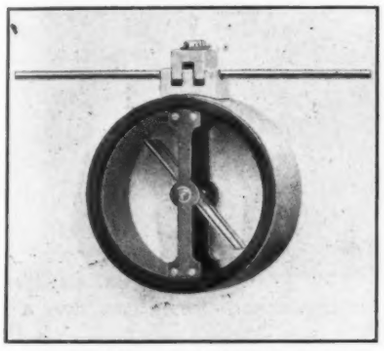
hoisted at speed of 2,500 feet per minute in this type of hoist, whereas with steam hoists provided with the best available safety devices the maximum allowed speed is but 1,200 feet per minute.

The first cost of installation is of course somewhat greater than for a small motor hoist with rheostat control, but the reduction of power cost due to the equalization of the load is so great that the initial expenditures becomes a secondary matter, especially when power is purchased on a maximum-demand system.

Figure 2 shows the hoist motor, the drums and the operator's platform at the Calumet and Arizona Company's Bisbee plant.

Electrostatic Voltage Indicator.

This electrostatic voltage indicator consists of an aluminum needle swinging in a glass case between two vertical metal posts. The whole device hangs from the line, being held in place by the screw clamp located at the top.



ELECTROSTATIC VOLTAGE INDICATOR.

If no voltage is impressed on the line, the needle assumes a vertical position, one end being slightly the heavier. It is then out of sight between the posts. On the other hand, if the line is alive, the needle is swung toward the horizontal position, and becomes visible giving a positive indication of voltage.

These indicators, which are made by the Allgemeine Electritäts Gesellschaft are applicable to lines of all potentials between 3,000 and 75,000 volts. For voltages under 10,000 the instrument, for greater safety, is provided with a ground wire.

The accompanying illustration shows an electrostatic voltage indicator attached to a high-voltage power line.

Devices for Transforming Gas and Oil Automobile Lamps Into Electric Lights.

Owing to its convenience and cleanliness electricity enjoys a great superiority over gas or oil for automobile lighting. The ability to turn the lights on or off instantly without even slowing up the machine appeals strongly to the automobilist. The General Electric Company is now manufacturing some new devices which can be used to convert gas or oil lamps into electric lamps, the electric current being furnished by a storage battery.

The bayonet-base socket bracket and six-inch reflector for converting gas lamps into electric is attached to the gas pipe in place of the gas burner, and is held in position by means of brass nuts. The lamps may be focussed by screwing the reflector forward or backwards on the socket, the reflector being made accessible for this operation by merely opening the door of the lamp. The reflector is nickel plated, highly burnished and in the form of a true parabola.

CONVERTED AUTOMOBILE LAMP.

The bayonet-base candelabra socket for converting oil lamps into electric is very simple in design and can be readily attached to the oil burners without disturbing them and can be so adjusted that when the bulb is removed the socket does not interfere with the oil flame.

The three-circuit snap switch, flush type, has a sturdy porcelain base on the back of which is mounted the terminal plates and battery busbar with binding screw for each conductor. This switch is designed to go on the back surface of the dash or in some other convenient place, the switch handle being the only part which shows on the front.

Extra terminal connections are provided so that if desired the electric horn and the speedometer light may be wired to it. The switch handle may be removed by turning it backward, thus preventing persons interfering or tampering with the lights on the car which may be left standing unattended. The busbar feature eliminates all joints, splices, etc., and makes it a very simple matter to install.

The flush tumbler switches, both "on" and "off" positions, are controlled by one and the same lever, thus reducing the number of levers and simplifying the control of the lights. The four-gang switch is recommended for five-light equipments, one switch being used for the tail light, one for the two side lights and one each for the headlights. The busbar feature is provided on two, three and four-gang switches, giving the same advantages as described above.

Surface tumbler switches are similar to the flush tumbler switches with the exception that they are adapted for mounting on the surface, and require that holes be drilled through the surface on which it is mounted for contact leads only.

The push-button switch is designed for use where the space is very limited. The push button is of metal, insuring that it will not break off. The plate on which the terminals and contacts are mounted is fastened to the frame with two long screws, effectually preventing its jarring loose. This switch has the busbar feature described above in connection with the tumbler switches.

Electrically Operated Typewriter.

An addition to the labor-saving devices for offices has been made in the form of an automatic typewriter. This is an electrically driven machine which makes original typewritten letters of any form letter filling in separate addresses and addressing envelopes for each letter.

The automatic typewriter operates on the same principle as the piano player inasmuch as there must be a stencil prepared for each letter and list of addresses. The automatic typewriter may be operated from any electric-lamp socket and is very speedy. The advantages are many for the busy office as all the stenographer has to do is to make the stencil and insert in the machine together with the letter paper and turn on the electric current.

Steel Casing for Wires.

A steel-conduit system of casing and capping for insulated conductors has been brought out in England. It consists of a shallow trough with a thin sheet-metal cover sprung over. The system is said to combine the advantages of the wooden molding, conduit, and to some extent the cleat systems. The wires are simply laid in, and no drawing in or threading is needed.

FIG. 1.—PRESSED-STEEL ELBOW.

They can easily be inspected at any time merely by pulling off the capping. The system is fireproof, damp-proof and well bonded, is light to handle and quickly erected. It is neat in appearance and especially suitable for surface work. It is of light section, consequently there is little or no condensation of moisture, and freight charges are small. The casing is made in short lengths, from three to six feet, with joint pieces, tees, special hand-bendable joints and boxes for junctions, switches, etc.

Two new parts have recently been

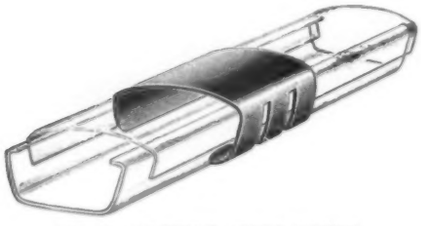


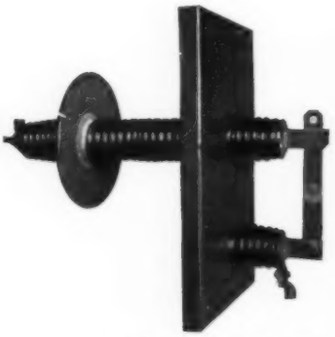
FIG. 2.—LOCKING JOINT COVER.

added which greatly improve the system. Fig. 2 shows a locking joint cover or cap. This is sprung over the casing and capping by hand, the deep side being placed first. It cannot be removed when in position, except with a tool such as a screw-driver. The object of this device is (a) to lock the capping to the casing so that it cannot be pulled off by hand, and (b) to cover the butt joints of the capping. It is especially recommended in installations where the casing is subject to much vibration or where mischievous people might interfere with it as in schools. Fig. 1 shows a pressed-steel elbow of the same section as the casing and capping. This fitting enables a sharper angle to be obtained than can be made with the smallest of the hand bendables, which are notable features of the Woodhouse system.

Woodhouse casing is made by the Woodhouse Steel Casing Company, London, and has been designed mainly for surface work, so as to permit of a periodical inspection of wires, as any part of the installation can be easily opened up and any section tested without difficulty and at small cost. It is important that this inspection should be made at regular periods so long as insulating material is used which deteriorates with age.

A New Disconnecting Switch.

The demand for an increased factor of safety in high-tension transmission systems has developed the need of station entrances which not only permit ready access to the equipment but also incorporates a disconnecting feature, thus enabling an operator to quickly isolate a given feeder or set of busbars.



DISCONNECTING SWITCH

One of the recent developments for this service is the type of entrance tube and disconnecting switch illustrated herewith and manufactured by the Delta-Star Electric Company, Chicago. The disconnecting switch is of the combination front-and-back-connected type, the long insulator being carried back through the supporting base and in turn having mounted upon it a disk insulator.

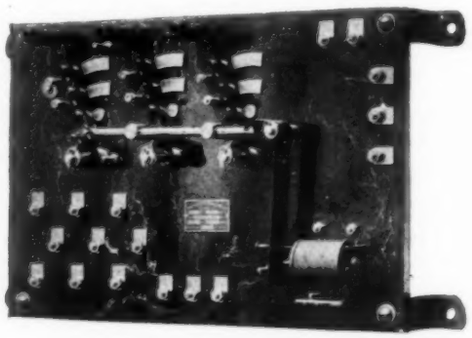
This insulator is provided with a copper core to one end of which is attached a locking type switchblade, the other end being provided with a suitable lug, to which the incoming line wire is soldered.

To mount the device in position it is simply necessary to leave a circular hole in the station wall and secure the mounting base in position by means of four expansion bolts or studs. With this combination a permanent entrance is secured and one which is said to be proof against entrance of moisture, dust or insects.

Three-Speed Controller for Slip-Ring Motors.

There is nowhere a greater necessity for bringing motors rapidly to a stop than in the modern printing shop or press room, because of the liability of the machines suddenly to get clogged or out of adjustment and mutilate a number of papers. The method of stoping the motor must be simple, the means easy to reach and the action must be positive.

Controllers with the above requirements were recently installed in connection with two Cox No. 9 Multi-mailers in the mailing room of the *Drovers' Journal*, which is published at the stockyards, Chicago, Ill. Each mailer, which seals the wrappers of, and addresses the papers as they are run off is driven by a small 220-volt, three-phase slip-ring motor, mounted on the machine. For compactness, the rheostat and starting panel are also mounted directly on the mailer.



THREE-SPEED MOTOR CONTROLLER.

As may be seen from the accompanying illustration the three speeds are secured by moving the three starting handles in succession and thus cutting resistance out of the rotor of the motor. Two buttons are connected in shunt with the no-voltage release solenoid so that when either button is pressed the solenoid is short-circuited and the handles are allowed to go back to the off position. The buttons are located so that they may be easily reached by the operator when he wishes to stop the mailer to remove the stock of sealed

papers or to regulate any mechanical difficulty.

The controllers were designed and manufactured by the Independent Electric Manufacturing Company, Milwaukee, Wis.

The Electric Weigher.

In most industrial establishments where material is handled in bulk, the conveyer is rapidly superseding other methods of transportation. This has created the necessity for a new method of weighing at least as accurate as the scales used with the older methods of handling in barrows, cars, or other receptacles. The design of the electric weigher is the direct outcome of this necessity.

While material is in motion on a conveyer, the former method of leisurely direct comparison of its weight with standard weights is impracticable, and interruption of its motion for the purpose of weighing is distinctly disadvantageous. In order to weigh a continuous stream of material in motion, it is necessary to take into account the instantaneous weight of a definite part of the length of the stream and the speed at which that part of the stream is moving. While the problem was being studied with a view to adapting old methods of weighing and old methods of integrating to the new conditions, it was one which presented many serious difficulties. At a certain point, however, the idea of utilizing electricity was hit upon and the difficulties soon vanished.

The electric weigher consists of three elements, one corresponding to each of the three terms in Ohm's law. The first, to produce the electromotive force, is a dynamo; the second, to vary the conductivity of the circuit, is a rheostat; and the third, to measure the current, is a meter.

The dynamo is subject to the rigorous law that the electromotive force produced is proportional to the strength of the field and the number of conductors cutting across it per second. With a constant field and constant number of conductors in the armature, the electromotive force is directly proportional to the speed. The field is made constant by the use of permanent magnets. The demand for accurate electrical-measuring instruments has resulted in the development of special steels for permanent magnets and special methods of "ageing" after magnetization, so that it is now possible to procure magnets which, when properly mounted, show no deterioration whatever over indefinite periods of time. The rest of the dynamo, or magneto, consists of the usual parts, pole pieces, armature, commutator and brushes. The design of the dynamo and the range of current used are such that armature reaction is not allowed to enter as a disturbing factor; and multiple brushes of a highly perfected material developed in Europe, maintain indefinitely a perfect condition of the commutator, and bring the brush resistance under absolute control.

The second element, the rheostat, is controlled by scale beams of the usual lever and knife-edge type. Leaving for the moment the important question of the proper suspension of the conveyor, the construction of the rheostat will be described. The counterpoise of the scale is a cylindrical plunger, which is partly floated in mercury. With every change in the weight on the conveyor the plunger instantly adjusts itself to a new position, thereby at the same time changing the level of the mercury.

The rheostat proper consists of a large number of loops of wire placed in narrow vertical spaces at the two sides of the weigher. Each loop is connected to a platinum-tipped contact point on the inside of the mercury vessel. The current from the dynamo is led into the lower part of the mercury and leaves it by way of the highest contact point, which is below the surface of the mercury. In this way different portions of the total resistance are short-circuited in accordance with the weight.

The plunger constitutes a self-adjusting counterpoise, which operates frictionlessly. The mercury vessel is also a dash pot which quells all vibration. The upper part of the vessel is widened out to form a reservoir, which is partly filled with oil. This protects the mercury from the air and forms a trap to catch any fine dust which may get past the other safeguards mentioned below.

The meter is a form of ampere-hour meter, which has been used for years. It has a single rotating member floated in mercury and revolving in proportion to the flow of current. Friction and wear are eliminated, so that no change can be detected in the meter after years of use.

The method of calibrating the weigher is such, that it is only necessary to have a meter which will always go at the same speed when conveying a given current. This meter fulfils this requirement absolutely. The dial of the meter is, of course, graduated to read in units of weight.

The variation in the specific gravity of mercury, due to changes in temperature, is compensated for by making the mercury vessel of an insulating material whose coefficient of expansion just offsets that of the mercury. To illustrate the importance of this it may be noted that the difference between the expansion of iron and of mercury would cause a difference of one per cent in the recorded weight between winter and summer, if plunger and mercury vessel were made of iron.

The conductivity of most conductors of electricity, of course, varies with temperature, increasing in some materials while decreasing in others. Effective means for balancing these variations have long been in use, and in the electric weigher the materials are so chosen that the meter has the same rate for a given weight and dynamo speed regardless of the temperature.

In connection with the above, the calibration of the weigher will explain its remarkable accuracy. Each resistance loop is provided with an adjusting rider astride of its two wires. The rider short-circuits the part of the loop beyond it. By moving the rider, an extremely fine adjustment of the resistance of the loop is made. Standard weights are suspended from the scale and the dynamo is run at a known speed and each loop is adjusted until the meter is exactly correct for the corresponding weight. The riders are then soldered permanently in position and the weigher is ready for service.

The electrical system lends itself readily to the attachment of distant indicating and recording instruments of the utmost value, without complication. By simply running two small wires from the totalizing instrument, referred to above as the meter, instruments may be placed in the office of the superintendent or elsewhere, which give a complete record of the tonnage carried by the conveyors. They also show immediately any slowing down or interruption in the feed and make a record of such interruptions, giving the exact time at which they occurred. These distant instruments are operated by an auxiliary circuit from a battery or other source.

White Way for New Haven, Conn.

New Haven's "Great White Way" was formally opened on the evening of December 16 by Mayor Frank J. Rice, who closed a little silver switch which controlled the current to the seventy-five arc lamps which have been installed on Chapel and Church Streets. At the same time New Haven's new slogan sign, "Old Elms But New Ideas," was disclosed to view, and the current also switched upon it by the mayor. The opening was celebrated by an extensive parade. All the wiring for the installation was supplied by the Okonite Company.

Although the inauguration of the new street-lighting system for New Haven is in many ways similar to the work being done in cities and towns throughout the country for better street lighting, the event in this case was made of special significance in view of the fact that a big business and real-estate boom is under way, and all of the merchants contributed in a notable way to make the parade and exhibition of floats as extensive as possible.

There were a number of electrical men from out of town entertained at a reception at the Quinnipiac Club before the celebration, among those present being Frank J. Rice, Mayor of New Haven, Joseph C. Johnson, George F. Hayes, Frederick D. Adams, George D. Post, John B. Kennedy, L. G. Martin, Theodore Beran, L. H. Lewis, W. C. Andrews and Harry Ley.

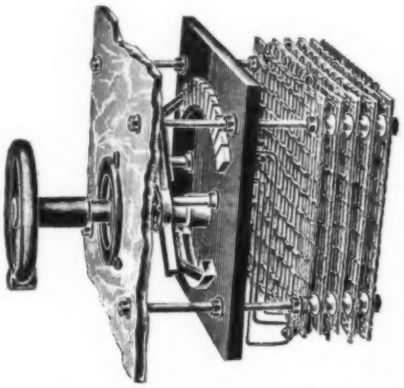
The electrical decorations displayed in the show windows and in the shape of festoons and outline lighting were conspicuous. The illustrations herewith show the street lamp, which was manufactured and supplied by the General Electric Company, and the lamp standard. Among the floats representing the various industries participating in the street-lighting movement was that of the Okonite Company, an illustration of which is shown herewith.

NEW LAMP STANDARD AT NEW HAVEN.

OKONITE FLOAT IN PARADE.

Woven Resistance Elements.

An interesting line of rheostats, car heaters and electric cooking devices has recently been placed on the market by a German firm, with the resistance or heating elements made of wire interwoven with asbestos threads. The resulting webs form stiff grids which are assembled in various ways, one of which is shown in the accompanying illustration. It is claimed that the asbestos interweaving holds the wires firmly so that the grids can be placed close to each other without buckling; that they will stand steady jarring, that they can be immersed in oil if desired, that they are light in weight in proportion to their energy consumption and that they are easily adapted to all sorts of uses.



RHEOSTAT WITH SPECIAL RESISTANCE ELEMENT.

Besides offering complete motor-starters, theater dimmers and heating appliances utilizing these woven-wire resistances, the maker, C. Schniewindt, of Westphalen, Germany, also sells the woven elements separately. He offers them in weaves having carrying capacities of from 2 to 60 amperes at continuous loading, each size being adapted to carry a 50-per-cent overload for one minute or a 100-per-cent overload for twenty seconds. They are sold by the square decimeter, the price including the needed terminals and connection pieces for assembling the units in groups.

Installing Taylor Stokers.

The New York, New Haven and Hartford Railroad Company is to install two more Taylor Stokers in its Bridgeport plant. These two stokers are in addition to the 2,000 horsepower of Taylor stokers already in operation.

Railway Electrification in Chile.

The committee charged with the work of studying the advisability of electrifying the Government railway from Valparaiso to Santiago, Chile, with the branch to Los Andes, covering a distance of about 150 miles, has made a favorable report and placed the cost, if done by the Government, at $10,888,460 United States gold, while it is reported that an American electric company has offered to do the work for $5,424,400.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Argument on the appeal of the Public Service Commission and the Long Acre Electric Light & Power Company for the dismissal of a writ of certiorari obtained by the New York Edison Company was heard before the commission of the First District. The Commission recently gave the Long Acre Company permission to issue $2,000,000 in stock and $4,000,000 in bonds, preparatory to supplying light and power in competition with the Edison Company. Morgan J. O'Brien, who appeared for the Edison Company, argued that the Edison Company should be protected in its monopoly. He said the Long Acre Company had never legally exercised its franchise and that it was mortgaged for $1,000,000. He insisted that there was no need for a competing company, which, he declared, would not only make serious inroads in the receipts of the established company, but would give no corresponding benefit to the public. He said the State had adopted the policy of regulated monopoly in the place of competition and that the Edison Company was supplying electricity at a rate which gave only a fair return on the value of its property.

Frederick W. Whitridge, as receiver of the Third Avenue Railroad Company, the Forty-second Street, Manhattanville & Saint Nicholas Avenue Railroad Company, the Dry Dock, East Broadway & Battery Railroad Company, and the Kings Bridge Railway Company has made application to the Public Service Commission for a rehearing on the order for free transfers in Manhattan, issued by the Commission to take effect January 1, 1912. The petition asks for rehearings on the ground that the order is unjust and unwarranted, and contrary to the weight of evidence.

The Public Service Commission, Second District, has made an order requiring the Warwick Valley Light & Power Company to show cause before the Commission at Albany, on January 8, why an order should not be entered requiring it to improve its distribution system in accordance with recommendations made to the Commission by one of its inspectors, and place the system in safe condition so that it will properly serve the public. The complaint was received by the Commission from the village trustees of Warwick and an inspector, after examining the plant, has pointed out various recommendations necessary to put the plant in proper condition.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

Elimination of the "zone" system of trolley fares and the substitution of a uniform charge based on mileage has been suggested by the Board of Public Utility Commissioners as a possible ultimate solution of the trolley rate problem. This suggestion was made in the Board's decision dismissing the complaint of the South Englewood Improvement Association against the New Jersey & Hudson River Railway & Ferry Company and the Public Service Railway Company. Concerning the suggested change in trolley fares, the Board said:

"While the immediate introduction of a radical departure from the present system is not before the Board, we incline to believe that eventually the entire zone system, together with the flat five-cent fare, will have to be replaced by a more rational and equitable system of charges. The rational system would seem to be a uniform basic charge alike for all passengers, plus a charge varying roughly with the length of the actual ride.

"The justification, roughly speaking, for such a basis, is as follows: Every passenger upon a trolley car requires from the motorman and conductor practically an identical service in having the car stopped twice and in having the fare collected. Every passenger, also, irrespective of the length of his ride, benefits by the existence, maintenance and operation of certain parts of the transportation property such as the electric plant with its supply of power.

"It would therefore appear that a uniform contribution, of basic charge, might justly be collected from every adult passenger irrespective of the length of his journey on the car. Over and above the uniform service rendered to every passenger, there is a service which roughly varies with the length of the ride which the passenger takes. There is more current generated and used, the longer the ride, as well as greater wear and tear upon the car and other apparatus. Both the cost to the company and the presumed benefit of the service to the passenger are greater, the longer the total ride enjoyed by the passenger.

"It would thus appear that a uniform basic rate or charge which permits without additional charge a ride of short but definite length might properly be accorded for a uniform basic fare, and that every mile or fraction thereof in excess should be paid for at a stipulated rate per mile.

"The eventual system of trolley charges must be a uniform basic charge, analogous to minimum charges made by certain other public utilities, plus a variable charge graduated roughly by distance traversed."

COMMISSION NEWS FROM OHIO.

(Special Correspondence.)

A motion asking for a mandamus compelling the Public Service Commission of Ohio, to pass upon the reasonableness of rates established by city ordinance prior to the formation of the Commission, will be heard by the Supreme Court of Ohio. The Bucyrus Light & Power Company recently filed an appeal with the Commission asking a review of rates fixed by the City Council of Bucyrus. The Commission refused to consider the matter upon the ground that the ordinance was in force prior to the existence of the Commission and that it had no jurisdiction. The decision will be of vast importance to all Ohio public service corporations. Since its formation the Commission has refused to take up any of the problems that existed at the time it was organized. It contends that to do so would mean the opening up of the whole field of past transactions for investigation, and that there are many outstanding securities which would be weakened by such action. A decision of the highest court is sought in an effort to ascertain the exact powers of the Commission, and upon the decision hangs a large amount of securities, which will be affected to some extent.

COMMISSION NEWS FROM MICHIGAN.

(Special Correspondence.)

By order of the Michigan Railroad Commission the rate for telephone service in Adrian will be reduced after January 1 from $5.00 to $3.00 for the use of two telephones in business places. It was argued that so long as the Commission had directed the consolidation of the two companies it was not fair for the company to continue charging the old rate for service by two phones which could just as well be furnished by one system, and claimed the company was continuing the two systems in operation for the purpose of securing additional revenue at the expense of patrons.

LIGHTING AND POWER.

(Special Correspondence.)

TAKOMA PARK, MD.—Plans are under way for a municipal lighting plant for Takoma Park.

GRAND SALINE, TEX.—The electric-light plant was destroyed by fire December 5, with a loss of $3,500.

STEAMBOAT ROCK, IOWA.—The Park Dam Company has been granted an electric-light franchise.

SHARON, PA.—Engineers have been engaged to submit plans and specifications for an electric-light plant.

CROWN KING, ARIZ.—The Pacific Copper Company plans for the installation of new pumping machinery. A.

RENO, NEV.—The Nevada Valley Power Company has been incorporated with a capital stock of $2,500,000.

TIOGA, TEX.—The City Council has granted C. B. Glasscock a franchise for an electric-light and power plant.

TIMPSON, TEX.—The Timpson Light & Power Company has been incorporated with a capital stock of $5,000.

RAY, ARIZ.—The Carney mine, operated by P. C. Carney, plans for the installation of new air-compressor machinery. A.

WASHOUGAL, WASH.—The Northwestern Electric Company has been granted a franchise to operate in this section.

WAKONDA, S. D.—The Wakonda Light, Power & Heating Company has been organized with a capital stock of $10,000.

COLUMBUS, O.—J. J. Henry is in charge of the plans for a central electric-power station in the Hocking Valley Coal district.

WATERLOO, IOWA.—Preparations are being made to install a system of cluster lights on Lafayette Street, between Fourth and Sixth Streets. C.

SUNNYSIDE, WASH.—The Board of Trustees' plans for the installation of a street-lighting system to comprise magnetite-arc lamps. A.

THE DALLES, ORE.—The Pacific Power & Light Company has been granted a franchise to maintain an electric-light and power plant here.

NASHVILLE, TENN.—The Great Falls Power Company will

spend more than $2,500,000 in developing the magnificent water power at Caney Forks Falls.

DELAWARE, O.—The City Council in regular December session granted a franchise of ten years to the Delaware Electric Light, Heat and Power Company.

PASCO, WASH.—The City Council has commissioned H. Day Hanford, engineer, Seattle, to prepare plans and specifications for a municipal electric-lighting plant. A.

PASADENA, CAL.—The Board of Commissioners has recommended to the City Council the installation of an electric-lighting system in Central Park to cost $800. A.

YOUNGSTOWN, O.—The Director of Service has been authorized to advertise for bids on material and supplies for the improvement of the electric-lighting system.

TOLEDO, O.—The Ohio Valley Power Company, organized by J. M. Ashley and others to build a power plant at Letart Falls, this week elected James M. Ashley as president.

REDLANDS, CAL.—Ornamental lights are to be installed in the business section of the city, the cost of which will be borne by the property owners and the city proportionately.

KEOKUK, IOWA.—The Keokuk Electric Company, incorporated in Illinois, has filed articles, capital stock $650,000. Incorporators include George Higginson, Jr., and Joseph L. Valentine. C.

BEAUMONT, CAL.—C. L. Nye and T. J. Barker, Riverside, contemplate the installation of an electric power plant on property recently acquired at the foot of Mount Grayback, Beaumont. A.

SACRAMENTO, CAL.—The State Board of Control will soon call for bids for about 25,000 electric lamps of stated capacities, for use in the state institutions during the coming year. A.

LAUREL, MISS.—The Laurel Light & Railway Company of Laurel has been incorporated with a capital stock of $500,000. P. H. Saunders, and S. M. Jones are among the incorporators.

ANETA, N. D.—The Aneta Light & Power Company has been incorporated with a capital stock of $10,000. R. J. Ball, Finley; G. W. Simpson and Harry Long, Aneta, are the incorporators.

FOND DU LAC, WIS.—The installation of a dynamo at the water plant for the purpose of generating electricity is one of the improvements contemplated by the Water Works Commission.

SAN JOSE, CAL.—The Sierra & San Francisco Power Company has established offices in this city. A branch line will soon be built which will connect the city with the main line of the company.

MANKATO, MINN.—The Consumers Power Company of this city has asked for electric-light franchises in Lake Crystal and Janesville, Minn., and will furnish light and power to Waseca, Minn.

OROVILLE, CAL.—Articles of incorporation of the Oro Development Company have been filed in the County Clerk's office. The capital is $1,000,000 and the purpose is to develop electric energy.

SAN FRANCISCO, CAL.—The Merced River Electric Power Company has filed articles of incorporation with 10,000,000 capital. The directors are L. M. Cove, H. L. Breed, Charles Fross, S. Hamilton, and J. L. Bowes.

GREENFIELD, MASS.—The Greenfield Electric Light and Power Company has recently purchased the electric light plant of South Deerfield and will ask permission to erect poles from Old Deerfield to South Deerfield.

GREEN RIVER, UTAH.—The Green River Irrigation Company is said to be planning for the construction of a large hydroelectric power plant on the Green River. Transmission lines will be extended throughout the valley. A.

ALTON, IOWA.—The Alton Electric Light & Power Company has been sold to the Mason Plumbing & Heating Company, who intend to move the plant from its present location over to their present plant, and improve it.

CALVERT, TEX.—The City Council has entered into a fifty-year contract with the Calvert Water, Ice & Electric Light Company. The company has agreed to make a number of improvements at an expenditure of $14,000.

FOND DU LAC, WIS.—Plans are under way for installing powerful dynamos in the Municipal plant, and when the franchise of the Western Wisconsin Railway & Light Company expires in 1913 a new plant will be in working order. C.

CLAYSBURG, IND.—The United Gas and Electric Company has under consideration the extension of electric lighting to Claysburg from Jeffersonville and along the gravel road to New Albany. The Town Board is to install street lights.

SOMERSWORTH, N. H.—The City Council is planning to place 200-candlepower lights on all street corners and large areas, in the business section and 60 to 80-candlepower lights where there is any distance between, and give all-night service.

HAVERHILL, MASS.—The Haverhill Advertising Association has undertaken to raise $12,600 for better street lights. It is proposed to install lights in clusters on trolley poles in the vicinity of the railway station and in the important business streets.

TWIN FALLS, IDAHO.—The City Council contemplates the installation of a cluster street-lighting system on Shoshone street, in the vicinity of the park and court house. The lights will be of three to five-light standards, spaced at intervals of 100 feet. A.

SACRAMENTO, CAL.—The Board of County Supervisors has notified the property owners of the Curtis Oaks district, near Sacramento, that a street-lighting system will be installed in that territory in the immediate future. The Curtis Oaks Improvement Club is interested. A.

ELWOOD, IND.—The Elwood Electric Light Company announces that as soon as it can obtain the necessary equipment it will begin the lowering of its poles in the business district and will install a conduit system. Nine miles of conduit will be necessary to make the change. S.

FRESNO, CAL.—Property owners on K, Belmont and Van Ness streets are planning for the installation of an electrolier street-lighting system. The fixtures will be bronze, four lights to the post, and are estimated to cost $100 each. Lewis H. Smith is interested in the improvement. A.

CREEDE, COLO.—The Cyrus Miller Leasing Company, of which J. H. Berkshire of Kansas City is president and controlling owner, has decided to undertake the sinking of a deep shaft on the famous old Amethyst property. This means the erection of an electric power plant immediately.

SPOKANE, WASH.—The Washington Steel & Iron Company has commenced surveys for its proposed hydroelectric power plant on the Wenatchee River, near Leavenworth. The construction of a concrete dam will soon be commenced. The plant will have a generating capacity of about 6,000 horsepower. A.

KEARNEY, NEB.—Preliminary work has been completed by the Oscar Claussen Engineering Company of St. Paul, Minn., for the furnishing of plans and specifications for the municipal street-lighting system. This system will include ornamental lighting posts on the down-town streets creating a real "White Way."

MANCHESTER, GA.—At a special election the town of Manchester voted in favor of the immediate issuance of bonds to provide for the erection and equipment of a modern electric-light plant to be owned and operated by the municipality. It is reported that plans for the structure have already been prepared.

PITTSBURG, PA.—An ordinance has been passed authorizing the Mayor and the Director of Public Works to advertise for bids and make a contract for the furnishing of electric lamps for the streets for a period of one year. Similar action was taken on an ordinance authorizing contracts for furnishing incandescent mantle lights for the city.

ALEXANDRIA, IND.—The Indiana Union Traction Company has made formal application to the City Council for an electric-light and power franchise on the basis of an eight-cent rate for lighting and a five-cent rate for power. The American Gas and Electric Company has also made application on the basis of a ten-cent maximum rate. S.

KNOXVILLE, TENN.—For the purpose of building an immense power plant to develop electricity for the operation of an aluminum plant, a Pennsylvania corporation has purchased the right of way for a distance of forty miles along the Little Tennessee River in Blount County, Tenn., and across the state line into North Carolina.

CLEVELAND, O.—The Cleveland Electric Illuminating Company has asked permission from the State Public Utilities Commission to issue $1,500,000 in new capital stock and the same amount in bonds, the money to be used in adding additional power-generating capacity to the new Lakeside plant and for extending the transmission system.

ANDERSON, IND.—The Board of Public Works has instructed the City Engineer to prepare plans and specifications for a new lighting system to be installed in the business district. It is proposed to remove the overhead street arc lamps and wires and substitute posts, five to a block, with a cluster of five lamps to a post. It has been estimated that about 350 posts will be required. S.

WHITE BLUFFS, WASH.—The Pacific Power & Light Company, which was recently granted a fifty-year electric-light and power franchise in Benton County, has completed the installation of an electric-lighting system at White Bluffs. The company has signed up many contracts for power in the valley and plans for the construction of an extensive distributing system for pumping and irrigation operations. A.

TWO HARBORS, MINN.—The City Clerk has been ordered to publish notice calling for sealed proposals for furnishing and installing complete in the city light plant, of a 300-kilowatt, sixty-cycle, single or double phase, electrical unit. Bids will be considered for direct-connected engine and generator, also for rope, pulley drive, engine and generator separately, said engine to be a condensing engine without condensor.

INDIANAPOLIS, IND.—The White River Corporation, with headquarters in this city and an authorized capital stock of $60,000, has filed articles of incorporation with the Secretary of State, with Alexander R. Holliday, John Holliday, Thomas C. McReynolds, L. C. Boyd, H. McK. Landen and Albert Baker, as incorporators and directors. The purpose of this company is to generate and supply electric current for public-service purposes.

ELECTRIC RAILWAYS.

(Special Correspondence.)

WYALUSING, PA.—It is stated on reliable authority that the electric road down the Wyalusing Valley will be built next summer.

WOODLAND, CAL.—The West Side Electric Railroad has been granted the right of way over all public roads covered by the surveys of the company.

SAN BERNARDINO, CAL.—A bonus of $14,000 has been raised for building a trolley line from the northwest section of the city to the business district.

BUTTE, MONT.—The North Butte Mining Company plan for the installation of an electric surface tramway system, with ore cars operated by electric motors. A.

BLUE RIDGE, TEX.—Most of the capital necessary for the proposed Greenville-Blue Ridge Interurban Railroad has been subscribed and a survey for the road has already begun.

WEST NEWTON, MASS.—Engineers have been at work locating the line which the West Penn street-car people intend building from Hunker to West Newton, a distance of ten miles.

FORESTVILLE, CAL.—The Petaluma & Santa Rosa Electric Railway Company plans for the extension of its system from Forestville to Heraldsburg, a distance of about seven miles. A.

SOUTHINGTON, CONN.—Attorney C. J. Danaher of Meriden, who holds a charter for the right of way for a trolley line to the summit of Meridan Park, has stated that the line will soon be built.

PHILADELPHIA, PA.—There is a campaign on foot for a trolley line over the new Walnut Lane Bridge to connect Roxborough with Germantown. The Germantown Business Men's Association are the instigators.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been granted permission by the Board of Public Utilities to electrify the Southern Pacific steam line from Sentous to Los Angeles, approximately eight miles. A.

TEMPLE, TEX.—The Pecos Commercial Club has a movement under way to build a railroad from Temple to Texico, N. Mex. The line will be 182 miles long and will have its general offices, round houses and machine shops in Pecos.

WASHINGTON, PA.—The Town Council has granted a franchise to a company for a street-car line to be built here. It is stated that work will be commenced on the new line in the near future. The line will extend to Charleroi.

NORTH ADAMS, MASS.—Word has been received that the State Railroad Commission has ordered the Berkshire Street Railway Company to build trolley extensions to the Kemp Park District and the loop around through the Hospital District.

PERRY, IOWA.—The Perry Electric Railway Company has been incorporated with the capital stock of $100,000. The following officers have been elected: B. C. Dilenbeck, president; Charles E. Wilson, secretary, and J. E. Hambright, treasurer. C.

SUNNYVALE, CAL.—It is planned to build an electric line from Sunnyvale to San Francisco Bay and to connect the new road with the San Jose Terminal Railway, thus giving Sunnyvale electric connection with all neighboring towns to the south.

IOWA CITY, IOWA.—It is stated that local stockholders of The Iowa City-Ottumwa Interurban Railway Company will furnish $1,500,000 and that work on the proposed interurban will be commenced next year. The line will be built to Keota, at least.

M'CONNELLSBURG, PA.—Rights of way for the Hagerstown, Greencastle and Mercersburg line have already been secured and the promoters state that work on the construction will commence soon. A power plant will be erected upon the completion of this line.

SAN FERNANDO, CAL.—E. D. Goode, Glendale, and C. P. Grogan, San Fernando, plan for the immediate construction of an electric-railway line from North Sherman Way, Van Nuys, to Hubbard avenue, San Fernando, a distance of about eight miles. The line will be standard gauge. A,

DES MOINES, IOWA.—The Keokuk Electric Company, a Chicago corporation with $650,000 worth of capital stock, has filed articles of incorporation with the Secretary of State. R. H. Hodge of California is the president. This company will expend half a million dollars on building interurban railways in Iowa.

RED BLUFF, CAL.—The Redding & Red Bluff Electric Railway has completed surveys for its proposed line from Redding to Red Bluff, a distance of about thirty-five miles. The line will parallel the tracks of the Southern Pacific Railroad, and is said to be an extension of the Vallejo & Northern Railway. A.

ROCHESTER, N. Y.—There is a new trolley line proposed to run between Buffalo and Rochester. The proposed route will form an extension of the Buffalo and Williamsville Railway and form a continuation of the Buffalo and Depew Railway. These proposed routes join near the village of Batavia and will form one continuous connected line of railway.

MASSILLON, O.—New York capitalists in company with E. N. Hemperly, and City Engineer H. McC. Yost, inspected the route of the proposed Massillon, Wooster and Mansfield Railroad Company, with a view of furnishing money for the construction of an electric line between this city and Mansfield. It is said that $2,000,000 will be required to finance the project.

PHOENIX, ARIZ.—The Salt River Valley Electric Railway Company has been granted a twenty-five-year electric-railway franchise at Phoenix. The company proposes to commence the construction of a system between Phoenix and Scottsdale, a distance of about eleven miles. Other lines are planned to Glendale and Tempe. W. S. Furman and F. M. Winter are directors of the company. A.

MEDFORD, ORE.—The Oregon & Southern Railway has been incorporated in the state of Washington with a capital of $2,000,000 and is getting ready to build from Ashland, Ore., north to Medford, Central Point, Gold Hill, Eagle Point, Tolo and Grant's Pass, and from there southwest to Port Orford. This line will pass through rich farming, timber and mining lands. Construction work will soon be started from Medford to Jacksonville. The president of the new company is J. Arnold Doyle, and the general manager is H. M. Farren.

MACON, GA.—Plans are under way for the formation of the North Macon Street Railway Company. Formal applications have been filed for rights of way along Boulevard and North Avenues, across the river, and thence by way of Second and Third Streets southward. The petitioners are J. J. Cobb, Thomas B. West, and others. It is understood that the company will be ready to begin the construction of the tracks and equipment as soon as the charter is issued.

INDIANAPOLIS, IND.—If all the Interurban roads that are now planned are built in Indiana, the next two years will be an era of traction-line construction. Three roads out of Indianapolis, one to the southwest and two to the north, and several extensions to existing roads are ready for spring work; also a new road east and west out of Richmond, three roads out of Vincennes, an extension of the Evansville & Boonville line and an extension of the Indianapolis and Crawfordsville line to connect with the McKinley system at Danville, Ill. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

WARROAD, MINN.—Fox & Jewett are extending their telephone lines to the East.

WILLS POINT, TEX.—The Union Telephone Company has been granted a franchise here.

CLEBURNE, TEX.—The Cleburne Telephone Company will spend $50,000 on improvements to its system.

AURORA, NEB.—The Hamilton County Telephone Association is about to erect as exchange building here.

LINCOLN, NEB.—The Jack Morrow Flats Telephone Company has been incorporated with a capital stock of $10,000.

COLLEGE SPRINGS, IOWA.—The College Springs Mutual Telephone Company has been incorporated with a capital stock of $10,000.

MORAN, IND.—The Moran People's Telephone Company has been incorporated with a capital stock of $3,000. H. G. Hurless is named among the incorporators.

MAYSVILLE, MO.—DeKalb County Telephone Company has been incorporated with a capital stock of $25,000. W. H. Clay, E. A. Hofstatter and R. A. Payne are the incorporators.

SPOKANE, WASH.—The Mountain States Telephone and Telegraph Company will spend $1,000,000 in Idaho and Montana next year, building new toll lines and circuits to the Washington State line.

CANADIAN, TEX.—The Southwestern Telephone Company has purchased the Canadian Long Distance Telephone Company and will make substantial improvements in the properties and service generally.

HIGGINS, TEX.—It is expected that next year will see work commenced on a new telephone line from this place into Oklahoma to connect with the Pioneer Telephone Company, and also the new Bell line from Amarillo to Kansas City.

NEW YORK, N. Y.—The Manhattan Fire Alarm Company has been incorporated with a capital of $500,000, by Blandy, Moony & Shipman, William H. Woolverton, William F. Allen and William G. Besler. The company will manufacture electric alarm systems, etc.

DAYTON, WASH.—The Mount Vernon Telephone Company has commenced the construction of a line between Eckler and Granger Mountains, a distance of about twelve miles. The company will build a number of branch lines to ranger headquarters in the forest reserve. J. W. Stevens is president of the company. A.

LITTLE ROCK, ARK.—The Southwestern Telephone Company, with headquarters at Dallas, Tex., has closed the deal for the purchase of the Fort Smith independent line and all the State exchanges, excepting Little Rock, owned by the Southern Telephone Company. The deal for the purchase of the Little Rock exchange is awaiting action by the Little Rock City Council before it can be closed. The Southwestern company paid in the neighborhood of $1,000,000 for the properties.

ELECTRICAL SECURITIES.

Canadian Light & Power bonds will be listed on the Montreal Stock Exchange, January 1.

There is being paid off at the National Shawmut Bank, Boston, $10,000,000 one-year notes of the subsidiary companies of the Western Telephone & Telegraph Company. These notes were issued a year ago and quickly sold by commercial note brokers to banks without public offering. The cash for their payment is being supplied by the American Telephone & Telegraph Company. The refunding of these notes was part of the financing the American Telephone had in mind when it sold its issue of $55,000,000 stock last June.

Western Electric's Christmas present to its stockholders in the shape of an extra dividend of $2 a share totals $300,000, in addition to the regular quarterly dividend totaling $300,000.

The Public Service Company of northern Illinois has filed a mortgage to the Illinois Trust & Savings Bank covering an issue of $13,459,000 first refunding five-per-cent bonds. According to the terms of the mortgage the company may, for acquisition or other expansion, subject to specified limitations, issue escrow bonds to the extent of seventy-five per cent of such expenditures, but not to retire or discharge mortgage indebtedness existing against the same at the time of acquisition, and may also issue them to the additional extent in par amount of the principal of any and all mortgage indebtedness existing against such property or interest at the time of its acquisition.

A public offering will be made of $6,000,000 in Chicago Railways consolidated mortgage five-per-cent bonds by Harris, Forbes & Company and the National City Bank, of New York City. When approximately $1,000,000 more bonds for extensions and improvements have been issued this mortgage will be closed. The Chicago Railways Company operates a comprehensive street railway system of 452 miles and serves a population of 1,600,000. Gross earnings per year have increased more than $5,900,000 in the past three years, and totaled $16,671,000 last year.

DIVIDENDS.

American Cities Company; semiannual preferred dividend of three per cent, payable January 2.

American Power & Light Company; quarterly preferred dividend of one and one-half per cent, payable January 2.

Buffalo General Electric Company; quarterly common dividend of one and one-half per cent, payable December 30.

Carolina Power & Light Company; regular quarterly dividend on preferred stock of one and three-quarter per cent, payable January 2 to stock of record December 23.

Chicago City Railway; regular quarterly dividend of two and one-half per cent and extra one and one-half per cent, payable December 30 to stock of record December 19. A year ago the City Railway declared an extra dividend of two per cent

Dayton Power & Light Company; quarterly dividend of $1.50 per share on the preferred stock, payable January 15.

Detroit Edison Company; quarterly dividend of one and three-quarter per cent, payable January 15.

New England Telephone & Telegraph Company; a dividend of $1.75 per share, payable December 30.

Stark Electric Company; quarterly dividend of three-quarters of one per cent, payable January 15.

Union Switch & Signal Company; the regular dividend of three per cent on common and same on preferred stock, payable January 10 to stockholders of record December 30.

United Utilities Company; quarterly preferred dividend of one and three-quarters per cent, payable January 2.

Western Union Telegraph Company; quarterly dividend of three-quarters per cent, payable January 15.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEKS.

NEW YORK.

	Dec. 18.	Dec. 11.
Allis-Chalmers common	1⅜	2⅛
Allis-Chalmers preferred	7⅝	8½
Amalgamated Copper	66⅝	60⅝
American Tel. & Cable	*74	*74
American Tel. & Tel.	140½	138¼
Brooklyn Rapid Transit	77⅜	75¼
General Electric	155	151
Interborough-Metropolitan common	15¼	14⅛
Interborough-Metropolitan preferred	48⅝	46
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	81	81½
Mackay Companies (Postal Telegraph and Cables) preferred	71	71½
Manhattan Elevated	133¾	134
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	48	46½
U. S. Steel common	68⅝	61⅝
U. S. Steel preferred	111¼	109
Western Union	80½	77⅛
Westinghouse common	68½	64
Westinghouse preferred	*114	*114

*Last price quoted.

BOSTON.

	Dec. 18.	Dec. 11.
American Tel. & Tel.	140	138½
Edison Elec. Illuminating	295	290
General Electric	155	151
Massachusetts Electric common	22½	21½
Massachusetts Electric preferred	94¼	93½
New England Telephone (ex dividend)	157	157½

PHILADELPHIA.

	Dec. 18.	Dec. 11.
American Railways	45½	45¾
Electric Company of America	12	12
Electric Storage Battery common	54½	53½
Electric Storage Battery preferred	54½	53½
Philadelphia Electric	16	15⅝
Philadelphia Rapid Transit	23½	23
Philadelphia Traction	84½	84¾
Union Traction	51	53¾

CHICAGO.

	Dec. 18.	Dec. 11.
Chicago Elevated Railways common	30	29
Chicago Elevated Railways preferred	92	91½
Chicago Railways, Series 1	96½	95
Chicago Railways, Series 2	36½	34
Chicago Subway	½	⅜
Chicago Telephone	128¾	137½
Commonwealth Edison	135	133
National Carbon common	163	163
National Carbon preferred	118½	118

PERSONAL MENTION.

J. W. HOUSTON has resigned as electrical inspector of the Washington Avenue subway, Springfield, Mo.

JOSEPH O'NEIL, until recently city engineer of Leavenworth, has been made manager of the extension line which is to be built in Oskaloosa, Kans.

C. W. HITCHCOCK, district manager of the Bell Telephone Company, gave an illustrated talk on "The Interesting and Unusual in Our Business" to local employees at Utica, N. Y., recently.

ROBERT L. JAYNES, tenth Jupiter of the Sons of Jove, was the principal speaker at the banquet of the Columbus (Ohio) Electrical Contractors' Association on Tuesday evening, December 19.

F. L. JOHNSON has been appointed supervising engineer of the Southern Sierra Power Company, at San Bernardino, Cal. Mr. Johnson lately resigned his position as city engineer at Santa Barbara, Cal.

J. F. HENDERSON, division commercial superintendent of the Southwestern Telegraph & Telephone Company, took a trip to Northwestern and Southern Texas recently and consummated deals for the purchase of five exchanges and more than 100 miles of toll lines.

H. F. THURBER, vice-president and general manager of the New York Telephone Company, addressed the Telephone Society at its meeting in the Engineers' Building on December 19. Mr. Thurber took for his subject "The Merging of Competing Telephone Properties Viewed from an Operating Standpoint."

LOUIS A. BAUER, director of the Department of Terrestial Magnetism of Carnegie Institution, recently stopped at San Francisco en route for Washington. The non-magnetic ship *Carnegie* will return to Washington by way of Cape Horn. Dr. Bauer will return overland, joining the party at the end of their journey.

ANDREW N. FOX, manager of publicity, of the Benjamin Electric Manufacturing Company, Chicago, was host to the members and guests of the Chicago Advertising Association at luncheon on Wednesday, December 20. The brass band, of sixty pieces, of the Benjamin Electric Manufacturing Company, rendered a greatly enjoyed musical program.

EDWIN R. ROCKWELL, who for the past nine years has been president of the Guarantee Electric Company, Chicago, has severed his connection with that company. Mr. Rockwell has not definitely decided as to his future plans, but will no doubt continue in the electrical field. He has several offers under consideration and his many friends hope he will continue to take a prominent part in the commercial side of the electrical industry.

JOHN F. HAYFORD, director of the College of Engineering, Northwestern University, has a portrait adorning the front page of the University Bulletin for November 24. Professor Hayford was chosen as a member of the commission of engineers who are settling the boundary dispute between Costa Rica and Panama. A survey will be made by the commission of four engineers who are to assemble in Central America in January for this work.

JAMES BRONIS, of West Orange, New Jersey, a member of the Illuminating Engineering Society, the National Sales Managers Association, and many fraternal organizations, who has served in various capacities in the business development of The Moore Light Company for eight years, left the Moore Light Company December 15, to take up important work in a new organization. Mr. Bronis is well known in railway, lighting and textile fields.

ROBERT RIDGWAY, of New York City, has been appointed engineer of subway construction to take the place of Alfred Craven, who was recently promoted to the post of chief engineer of the Commission of the First District of New York. Mr. Ridgway is at present department engineer with the Board of Water Supply, engaged on the construction of the Catskill waterworks. He was engineer for the old Rapid Transit Commission from 1903 to 1905.

OBITUARY.

C. C. COKENAIR, a developer of Western water powers, died at Duluth, Minn., December 13. Mr. Cokenair was sixty-three years old. He leaves a widow and one son.

E. C. NORTON, vice-president of the Northwestern Cedarmen's Association, died on December 9 at his home in Escanaba, Mich. Mr. Norton was born at Burlington, Wis., in 1875. He went to Escanaba, Mich., thirteen years ago as cedar inspector for the Kinlock Telephone Company, of St. Louis, Mo., and afterwards organized an inspection bureau, serving a number of telephone companies. He next became local manager for the Kellogg Switchboard & Supply Company, in charge of its pole department, and continued in that capacity until three years ago, when he bought out the pole department and conducted a pole and post business under the name of E. C. Norton. He also organized the Norton Logging Company, of which he was vice-president and general manager at the time of his death. He was elected to the office of vice-president of the Northwestern Cedarmen's Association, last January, and was also a Knight Templar and a Shriner. He was married eleven years ago to Miss Mary McRae, of Escanaba, who, with two daughters, one aged eleven years and one eight months, survive him. The funeral was held at Escanaba, Mich., December 11.

DANIEL CARROLL HEMINGRAY, secretary and treasurer of the Hemingray Glass Company, died on Thursday morning, December 14, following an attack of paralysis. Mr. Hemigray was stricken on Tuesday afternoon while in his automobile on the way from the works of the Hemingray Glass Company in Covington to his home in Glendale. Shortly after the machine reached the Cincinnati side of the river, Mr. Hemingray complained to a friend who accompanied him of feeling ill and distressed, and the chauffeur was instructed to drive quickly to the Queen City Club. He was helped from the automobile and Dr. Harry H. Hines was summoned. Examination revealed that the stroke of paralysis was extensive and that it would be extremely dangerous to remove Mr. Hemingray to either his home or to a hospital. Dr. Walker and other physicians were called in consultation and a hard fight was made but on Wednesday evening he developed sinking spells and the physicians gave up hope of saving him. "Dan" Hemingray, as he was universally known, was one of the best known men in Cincinnati, and one of the most popular and highly esteemed men in the electrical fraternity. His jovial disposition and hale good-fellowship was a magnet that drew about him a host of friends to whom his death will be a sad blow. In Covington, Ky., he was a greatly respected citizen and to the large number of employees of the Hemingray Glass Company he had ever been a kind and comforting friend. He was interested in many local institutions, and a director and representative of several manufacturing concerns other than the Hemingray Glass Company. Mr. Hemingray is survived by his wife, who was Miss Clara Keck; his brother, Ralph G. Hemingray, president of the Hemingray Glass Company, of Muncie, Ind.; and his sisters, Mrs. Bradford Shinkle of Covington, Ky., and Mrs. W. G. Felix, of Lexington, Ky. He was born in Covington in 1857, a son of Robert Hemingray. At Woodward High School he was a classmate of President Taft. After graduating there he went to Chickering Preparatory School and later to the Massachusetts Institute of Technology. He returned to Cincinnati before his graduation there, and entered business with his father and brother Ralph. The funeral services were held in the chapel of Highland Cemetery near Fort Mtichell just outside of Covington, on Saturday afternoon, the Rev. James M. Magruder, pastor of Trinity Church, Covington, officiating. Because of the great number of friends of Mr. Hemingray it was decided to hold the services in the cemetery chapel, and arrangements were made for special cars to convey his friends from Covington and Cincinnati. A delegation of Muncie (Ind.) Elks, of which Mr. Hemingray was a member, attended the funeral in a body. The pallbearers were Harry Kinney, W. S. Perkins, Edward S. Grant, Frank Rothier, Alexander Lewis, Frank D. Lawrence, Frank Perin and W. A. Hopkins, of Cincinnati; B. M. Downs, of New York, and W. W. Low, of Chicago.

DANIEL C. HEMINGRAY.

NEW INCORPORATIONS.

SPOKANE, WASH.—The W. G. Chaney Company (telephone, telegraph, etc.) has been incorporated with a capital stock of $50,000. W. C. Jones is named as incorporator.

WICHITA FALLS, KANS.—The Falls Electric Company has been incorporated with a capital stock of $5,000. K. K. Kemper, T. L. Farmer and H. V. Culp are incorporators.

NEW YORK, N. Y.—The Viking Electric Company has been incorporated with a capital of $10,000 to manufacture electrical appliances. The incorporators are Frank W. Burr, Aubrey E. Noble, Benjamin I. Carhart and William T. Smith.

FOREIGN TRADE OPPORTUNITIES.

(From Daily Consular Reports, issued by the Bureau of Manufacturers. In replying please mention file number.)

NO. 7716. ELECTRIC CRANES FOR PORT.—Bids for the supply of thirteen electric cranes for the port of Montevideo, presented in sealed envelopes and on stamped paper, will be received by the Secretary of the Body of Administration of the Port (Secretario del Consejo de Administracion del Puerto, Calle de Piedras No. 156, Montevideo, Uruguay) until February 6, 1912, at No. 156 Piedras street, Montevideo, Uruguay. The conditions, specifications, and further particulars can be obtained from the consul general of Uruguay, 17 Battery Place, New York, N. Y.

NO. 7686. TENDERS FOR ELECTRIC LIGHTING AND SUPPLIES.—The American consulate at Quebec has forwarded copies of tenders for electric lighting called for by the city of Quebec. It will be impossible under prevailing conditions for American concerns to submit tenders for the lighting system, but the requirements call for certain lamps and arc lights, and American firms may desire to correspond with the successful bidder for the purpose of supplying the lamps, arc lights, and such other devices as may be required to comply with the tender. About 300 ornamental iron or metal posts will also be required, and the consul desires catalogues from American manufacturers, giving prices, etc. Copy of the complete report and form of tender can be obtained by interested firms upon application to the Bureau of Manufacturers.

NEW PUBLICATIONS.

TECHNOLOGY AND INDUSTRIAL EFFICIENCY.—Under this title the proceedings of the Congress of Technology, held in Boston, last April, at the Massachusetts Institute of Technology, have been printed. The volume contains about 500 pages. Some seventy papers are included, and these form a valuable record of the present state of industrial science, and present some of its problems with the probable solutions. The six sections into which the Congress was divided are represented by papers on: "Scientific Investigation and Control of Industrial Processes;" "Technological Education in its Relations to Industrial Development;" "Administration and Management;" "Recent Industrial Development;" "Public Health and Sanitation;" "Architecture."

ANNUAL REPORT OF NEW YORK STATE PUBLIC SERVICE COMMISSION, SECOND DISTRICT.—The fourth annual report of the New York State Public Service Commission, Second District, has been issued in two large volumes, and covers the work of the Commission for the year ended December 31, 1910. The total number of corporations, municipalities and individuals engaged in serving the public in some capacity, or incorporated for the purpose, under the supervision of the Up-State Commission is 944; street railroad corporations numbering 129, electrical corporations 301, and telephone corporations 135. The total number of hearings given by the Commission was 554, an increase of 139 over the number for the year 1909.

BRITISH STANDARD SPECIFICATION FOR HARD-DRAWN COPPER WIRE.—The fifty-fifth report of the Engineering Standards Committee, which has recently appeared, is devoted to experiments on hard-drawn copper and bronze wire. Certain funds were provided by the General Post Office and the National Telephone Company, the two largest users of telegraph and telephone wire, for the Engineering Standards Committee, for the purpose of carrying out experiments at the National Physical Laboratory, the object being to obtain some independent data regarding the breaking stress of hard-drawn wire of small diameter when used for telegraph and telephone purposes. Much ground has been covered by these experiments, which included an investigation into the variation of mechanical properties of these wires due to differences of make, diameter, length, and temperature, as well as variations of strength caused by the kinking of the wire, this kinking having apparently more influence on the strength than has hitherto been appreciated. The testing arrangements are described in the report, and several very complete tables and curves are given which show the total extension and the breaking load for different wires. The influence of kinks on the modulus of elasticity of the material is clearly shown by the figures given.

PROPOSALS.

WIRING, CONDUITS, ETC., FOR POWER STATION.—Proposals will be received by the Board of Trustees for the Water-Works and Improvement Bonds of the city of Jacksonville, Fla., until 3 p. m. on Thursday, January 4, 1912, for furnishing complete the following:

Electric conduit work for new power station.
Wiring and fixtures for new power station.
Conduit work for changes in old station.
Certain wiring and fixtures for old power station.

Plans and specifications are on file at the office of the Board in Jacksonville and the Scofield Engineering Company of Philadelphia. Copies may be had from the latter upon deposit of $25.00 to insure the return of same. Bids shall be in duplicate and shall be accompanied by a certified check on a Jacksonville bank to an amount of ten per cent of the bid. Bids are to be addressed to the chairman of the Board and marked "Bid for Conduits and Wiring."

INDUSTRIAL ITEMS.

THE WARNER ARC LIGHT COMPANY, Wilton Junction, Iowa, is considering the erection of a manufacturing plant in Pekin, Ill. The company already has five plants in operation.

THE HARTER MANUFACTURING COMPANY, Chicago, Ill., lists its line of lighting fixtures in a recent catalog. The "Adlite," "Reflectolier," and other specialties are illustrated, in addition to the regular fixtures for tungster clusters.

THE BONNELL MANUFACTURING COMPANY, Cleveland, O., describes its combination box in a recent folder. The selling point featured in connection with this box is that it has "more combinations and less fittings than any heretofore offered."

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., calls especial attention to the value of effective holiday window displays, in the December number of the *Emerson Monthly*. Other items deal with new pieces of motor driven machinery, etc.

WORCESTER ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., has just completed the construction of a four-story brick addition to its factory. The new building is 40 by 60 feet and will have 7,200 square feet of floor space. Enlargement had become necessary owing to a rapidly increasing business.

THE ROBB ENGINEERING COMPANY, Ltd., South Framingham, Mass., reports recent sales of horizontal return-tube boilers to the following companies: Merrimac Chemical Company, The Plimpton Press, J. A. Lord, American Agricultural Chemical Company, F. S. Carr Company, C. J. Norwood, R. Wolfenden & Sons.

THE SHELBY ELECTRIC COMPANY, Shelby, O., recently made a number of installations of high-wattage Mazda lamps in business houses in Columbus, O., including those of F. & R. Lazanis, the Columbus Dry Goods Company, Capitol Clothing Company and The Fashion Store. These installations were erroneously stated last week to have been made in Cleveland, O.

THE McDONALD SPIKED CONCRETE TIE COMPANY, Los Angeles, Cal., announces that it has acquired certain rights to the McDonald spiked concrete-tie patents, as successor to the old McDonald Company; and it will engage in business relating thereto in the United States. H. P. Wendt, having severed his connections with the old company, has been appointed general manager of the new concern.

THE GENERAL VEHICLE COMPANY, New York, N. Y., announces in the December number of *Elec-Tricks* that in the future a part of that monthly publication will be given over to explaining "Kinks" in the operation and maintenance of electric vehicles. Suggestions are invited from readers. The company also announces that it has adopted a new trade-mark. This consists of a monogram "G. V." inclosed in a hexagon. Above are the words "General Vehicle" and below "Greatest Value."

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, Ill., has issued two catalogs listing its clamp-sockets, bushings, porcelain-enameled steel shades and specialties. The contents of these two catalogs are identical, the only difference being that one is made in standard size for filing, while the other is prepared in pocket size, with strong binding and cloth mounted covers. Page numbers in both catalogs are the same ,and the idea has been carried out even in the mailing envelope, one being an exact miniature of the other.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., has received an order for the equipment of fourteen steel steamers with complete electric lighting plants. These plants will be installed in the steamers as they are completed in Pittsburgh for transportation to Para, Brazil, to ply on the Amazon River and its tributaries. The steamers are under construction in the shops of James Rees Sons, and form a part of a great fleet of river and ocean-going vessels for the Para Rubber Company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has published several bulletins covering its machinery and apparatus. Bulletin No. 1,625 describes quite fully the hydroelectric development of the Great Northern Power Company. The plant will ultimately generate 100,000 horsepower which will be distributed in the region at the head of the Great Lakes, and probably to the Mesaba and Vermillion mining regions. Bulletin No. 1,523 takes up a form of portable air compressor with a direct-connected alternating-current motor. Bulletin No. 1,524 contains a price list of repair parts for auxiliary air-brake apparatus.

THE UNITED STATES ELECTRIC COMPANY, New York, N. Y., announces that the Chesapeake & Ohio Railway, which has had for some time, more than 200 Gill selectors in service in telephone train dispatching, has now ordered fifty-two additional selectors for a farther extension of its circuits. The Central Vermont Railway, also a user of Gill selectors, has recently received from the United States Electric Company, thirty-one additional selective-station outfits with automatic sending keys for the dispatchers station. Another repeat order for Gill selector equipment recently delivered was from the New Iberia & Northern Railroad, in extension of its circuits.

THE MUNNING-LOEB COMPANY, Matawan, N. J., has published an attractive catalog, containing a complete description of its Optimus plating dynamo. Two and three-wire dynamos are illustrated and described as are also their belt and direct-connected motor-driven units. The value of the compound-wound plating dynamo is discussed and it is pointed out why these dynamos maintain a uniform voltage at from zero to 125 per cent overload and at the same time eliminate all sparking at the brushes. Test curves showing the performance are included and several pages in the back of the catalogs give interesting data of value to electroplaters. Copies of this bulletin may be had by addressing the Munning-Loeb Company, at Matawan, N. J.

DUNCAN ELECTRIC MANUFACTURING COMPANY, Lafayette, Ind., has issued Bulletin No. 21 containing instructions for installing, reading, cleaning, repairing and testing the Duncan watt-hour meters of the direct-current commutator type. This is a comprehensive pamphlet which goes considerably into detail and includes twenty-five diagrams of the connections to be used in installation and testing. Tables are given of the test constants for Model E and Model H meters. This bulletin will be found very valuable to men engaged in installing and testing meters, as well as others interested in this subject. Bulletin No. 22 by the same company describes Model R watt-hour meter, which is of astatic, shunted type for direct current.

DATES AHEAD.

American Association for the Advancement of Science. Annual meeting, Washington, D. C., December 27-30.

American Institute of Consulting Engineers. Annual meeting, New York City, January 16, 1912.

Northwestern Cedarmen's Association, Minneapolis, Minn., January 23 and 24.

Western Electrical Inspectors' Association. Milwaukee, Wis., January 23-25, 1912.

National Independent Telephone Association. Annual convention, Chicago, Ill., February 7, 8 and 9, 1912.

Minneapolis Electric Show, Minneapolis, Minn. March 16-23.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued by the United States Patent Office, December 12, 1911.

1,011,141. ILLUSTRATIVE TELEGRAPHY. Noah S. Amstutz, Cleveland, O. A series of vibrations is controlled and modified by photographic and electrical means, and recorded on a roll at the receiving end.

1,011,157. INSULATION-CUTTER. Emil F. Chytraus, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J. Curved jaws with a double knife edge receive the wire, a turn of the tool making a circumferential cut in the insulation.

1,011,160. MERCURY RECTIFIER. Francis P. Coffin, assignor to General Electric Co. Has an exhausted metal envelop and an insulated metal lining.

1,011,164. INSULATOR. Samuel S. Cornelius McDowell, Mo. An insulating wire-receiving block is held in a support bolted to a wall or pole.

1,011,165. ELECTRIC REGULATION. John L. Creveling, assignor to Safety Car Heating & Lighting Co. The apparatus is operated by either voltage fluctuations or current fluctuations.

1,011,166. ELECTRIC INCANDESCENT LAMP AND HOLDER. Charles Damey, London England. Spring actuated plungers on the lamp base engage apertures in the lamp socket.

1,011,168. TELEPHONE SYSTEM. William W. Dean, assignor to Dean Electric Co., Elyria, O. Has tuned ringers, impulses of varying frequencies being sent by manually operated levers.

1,011,169. IGNITION DEVICE. William W. Dean, assignor to Dean Electric Co., Elyria, O. A resistance device is connected in circuit with an induction coil.

1,011,175. COMBINED ELECTRIC DOOR-BELL AND FIRE-ALARM. Charles E. Egan, Lafollette, Tenn., assignor to John M. Schuster, Columbus, O. A thermostatic circuit closer is connected in an electric-bell circuit.

1,011,184. BOTTLE-FILLING DEVICE. Joseph H. Godfrey, Chicago, Ill., and Leslie J. Housel, Madison, Wis. The spout is surrounded by an electromagnetic coil, the armature being inside the spout, and connected to a valve; the electromagnet

is connected in circuit by a float, working with change of level.

1,011,210. CABLE-RELAY APPARATUS. Isidor Kitsee, Philadelphia, Pa. Two windings are connected in the line, an impulse in one producing a dot at the receiving instrument, a similar impulse in the other producing a dash.

1,011,211. BLADE SHARPENER. Phillip E. Kopp, Kansas City, Mo. A sharpener for razor blades is propelled by a small electric motor.

1,011,212. ALTERNATING-CURRENT CONTROLLER. David Larson, Yonkers, N. Y. Has laminated frame and pole piece, and means for adjustment of pole piece.

1,011,232. ELECTRICAL SAFETY-FUSE. Georg Müller, Schwäbisch-Gmünd, Germany. A plug containing the fuse slips into a contact member.

1,011,240. ELECTRICAL CONTROLLING APPARATUS. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. Relates to the construction of the casing and placing of switch contacts.

1,011,258. GALVANIC BATTERY. Edward C. Smith and Edward L. Marshall, assignors to National Carbon Co., Cleveland, O. A zinc element is placed at a considerable distance from the bottom of the jar, and above a resistance plate; the electrolyte used contains caustic alkali.

1,011,267. MOTOR CONTROL. August Sundh, Yonkers, N. Y. Fluid is propelled to actuate the accelerating mechanism in proportion to the speed of the motor, the flow being controlled automatically or manually.

1,011,268. MOTOR CONTROL. August Sundh, Yonkers, N. Y. Has sectional starting resistance and magnetically operated clutch devices.

1,011,269. ELECTRO-HYDRAULIC SPEED-GOVERNING DEVICE FOR POWER TRANSMISSION. August Sundh, Yonkers, N. Y. A number of pumps are operated in connection with a number of motors.

1,011,291. RAILWAY SIGNALING SYSTEM. Herbert A. Wallace, New York, N. Y., assignor to Union Switch & Signal Co., Swissvale, Pa. Has electrically operated block signals.

1,011,328. THERMOSTAT DAMPER-REGULATOR. Ruel E. Dewey, Grand Rapids, Mich. A motor connected and disconnected by means of a thermostat, opens and closes the dampers of a furnace.

1,011,357. ELECTRIC LIGHTER FOR CIGARS. Thomas P. Moody, Chicago, Ill. The combination of a wick tube, and means to produce initial and secondary sparks in rapid succession at the mouth of the tube.

1,011,376. RHEOSTAT. Gustave A. Scheeffer, assignor to Columbia Meter Co., Indianapolis, Ind. A metalic rod threaded at the ends carries resistance coils and insulated connector plugs, the plugs being clamped in position between the coils.

1,011,396. METHOD OF AND APPARATUS FOR THE TREATMENT OF LAMP FILAMENTS. William G. Abbott, Jr., assignor to General Electric Co. The filaments are moved continuously through a treating gas.

1,011,402. AUTOMATIC ELECTRIC TRAIN-LINE COUPLING. William L. Bliss, assignor to the United States Light & Heating Co., New York, N. Y. A single guide on one side of the coupling member fits into two guides on the other side, automatically bringing the coupling into place.

1,011,405. TELEPHONE DESK SET. Peter C. Burns, Chicago, Ill., assignor to American Electric Telephone Co., Chicago, Ill. Includes a tubular support, and a lazy-tongs arrangement.

1,011,413. PROCESS OF ELECTRICALLY DECOMPOSING FLUIDS. William H. Cone, assignor to Laura G. Fixen, Chicago, Ill. Consists in passing a current of electricity through a stream of fluid, and withdrawing the decomposed product from the stream at a number of different points along its path.

1,011,439. MAGNET TERMINAL. William Kaisling, assignor to Kellogg Switchboard & Supply Co. A curved shank fits into a tubular portion, forming a rigid connection.

1,011,462. TROLLEY. Walker E. Marshall, assignor to Ira J. Scott, Danville, Ill. Arms are provided which keep the wheel on the trolley wire.

1,011,485. ELECTRIC BATTERY. Georg Pfleiderer, Gross-Lichterfelde, near Berlin Germany. Water necessary to the action of the battery is furnished by an ingredient containing water of crystallization, the water being given up when the battery is heated.

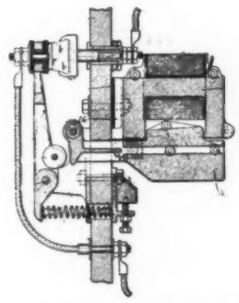
1,011,493. LIGHTNING-ARRESTER. Conway Robinson, assignor to General Electric Co. Comprises a number of carbon plates spared by insulated washers, and having cut-away portions to form an air-expanding chute.

1,011,503. ELECTRIC OZONIZER. Stanley Shepherd, assignor of one-half to William P. Shannon, Ottawa, Can. Has electrodes of solid metal and of corrugated sheet gauze separated by suitable dielectric material.

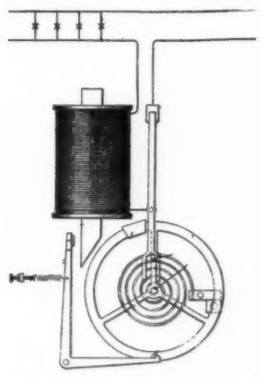
1,011,523. LAMP-MAKING MACHINE. Alfred Swan, assignor to General Electric Co. The stem is automatically sealed into the neck of an incandescent-lamp bulb.

1,011,526. VIBRATING RECTIFIER. Elihu Thomson, assignor to General Electric Co. A terminal contacts with mercury to deliver alternate impulses of current as direct current.

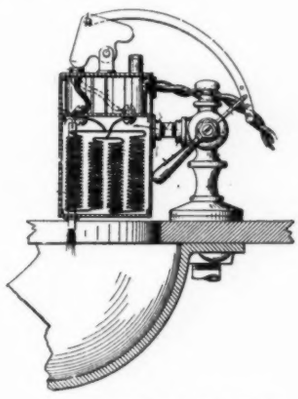
1,011,527. ELECTRIC SIGNAL SYSTEM. Walter V. Turner, assignor to Westinghouse Air Brake Co., Pittsburgh, Pa. Signals in a train are actuated by the closing of switches connected in local circuits along the track.



1,011,662.—ALTERNATING-CURRENT CONTROLLER.



1,001,732.—CURRENT-LIMITINC DECICE.



1,001,809.—WATER HEATER.

1,011,538. LIGHTNING ARRESTER. Ezechiel Weintraub, Lynn, Mass., assignor to General Electric Co. Vapor tubes are conductive to a voltage greater than a predetermined value, the arc being broken when the voltage drops.

1,011,544. SOCKET FOR INCANDESCENT ELECTRIC LAMPS. Herbert C. Wirt, Plymouth, Mass. A metallic cap for an incandescent lamp has means to hold an insulating lining in place.

1,011,546. CIRCUIT-CONTROLLING DEVICE. Jonathan E. Woodbridge, assignor to General Electric Co. An electrically actuated signal is rendered operative by opening one of the circuit-controlling devices, and inoperative by opening the other.

1,011,559. CARBON ELECTRODE FOR GALVANIC ELEMENTS. Stephan Benko, assignor to Company Limited for Exploitation of Inventions by Stephan Benko, Budapest, Austria-Hungary. Consists of a carbon body and a metal frame, the carbon body being impregnated with metal at its edge.

1,011,574. ELECTRIC-HEATED GLOVE. Arthur L. Carron, Binghamton, N. Y. Filed Sept. 9, 1911. Heating coils are contained in the glove.

1,011,586. APPARATUS FOR MAKING ELECTRIC-LAMP BASES. John Edward Criggal, assignor to the Previdence Gas Burner Co., Providence, R. I. The terminals are severed from the shell of the lamp base and are held in proper position preparatory to their permanent reconnection by insulating material.

1,011,595. SPARK-PLUG. Charles C. Eldridge and Edwin J. Beebe, Marshalltown, Iowa. The end of the tube containing the electrode is substantially parallel to it, so that a relatively large spark is formed.

1,011,600. LINE-TAPPING DEVICE FOR TELEPHONE AND OTHER CIRCUITS. Clarence B. Forrest, Middleport, O. A pair of clips carried by a pole are attached to wires leading to the telephone instrument; the pole is detached from the clips when these are in position.

1,011,602. AUTOMATIC BLOCK-SIGNAL SYSTEM. Walter E. Foster, Chicago, Ill. The signals are electrically operated.

1,011,616. ELECTRIC INSTRUMENT. Edward A. Halbleib, assignor to Northeast Electric Co., Rochester, N. Y. Has two relatively fixed magnets, one of which is an electromagnet; a paramagnetic armature is located between the magnets.

1,001,639. ELECTRIC SWITCH. Thomas E. Murray and William T. Dempsey, New York, N. Y. A bifurcated gang plug has legs of unequal length which enter pairs of clips, making proper connection.

1,011,652. STRAIN-INSULATOR. Louis Steinberger, New York, N. Y. Sleeves of insulating material have a frustro-conical form, the strain members fitting into these sleeves.

1,011,662. SWITCHBOARD CONSTRUCTION FOR ALTERNATING-CURRENT CONTROLLERS. August Sundh, assignor to Otis Elevator Co., Jersey City, N. J. A pivoted electromagnet causes a lever to vibrate, making and breaking the circuit; springs are arranged so as to absorb the jar.

1,011,663. ALTERNATING-CURRENT ELECTRO-MECHANICAL CONTROLLER. August Sundh, assignor to Otis Elevator Co., Jersey City, N. J. Cams on a shaft behind the swtichboard operate the series of switches.

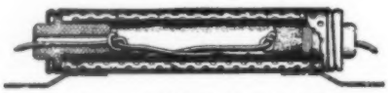
1,011,710. TERMINAL CLIP FOR ELECTRIC BATTERIES. Charles E. Avery, assignor to Manhattan Electrical Supply Co. Bent spring wire is coiled into concentric rings to form a securing eye.

1,011,723. TROLLEY WHEEL AND FINDER. Benjamin R. Beach, Fieldsboro, N. J. Has a spirally grooved roller so arranged that the trolley wire tends to keep to the center of the wheel.

1,011,732. CURRENT-LIMITING DEVICE. David Broido, assignor to General Electric Co. A spring device acts, during overload, to open the circuit, the circuit being closed again when normal load is resumed.

1,011,741. DEVICE FOR GROUNDING TROLLEY-CORDS. Frank E. Case, assignor to General Electric Co. The cord guide is permanently grounded.

1,011,744. PROCESS OF MAKING BIMETALLIC WIRE. Jean



1,001,825.—RESISTANCE UNIT.

Baptiste Clamens, Paris, France. A steel disc is coated with copper, the disc cupped and drawn over a steel bar; the resultant ingot being drawn into wire.

1,011,754. SNAP-SWITCH. Archibald S. Cubitt, assignor to General Electric Co. Legs of a bridging contactor are forced apart by a bow spring.

1,011,756. DEVICE FOR AUTOMATICALLY OPENING AND CLOSING VALVES. Gustaf Dalen, assignor to American Gasaccumulator Co. Two vessels, one light conducting and one light reflecting are connected in circuit with an electromagnet which actuates a valve as the light intensity changes.

1,011,757. MOTOR-CONTROLLING DEVICE. Maxwell W. Day, assignor to General Electric Co. Under abnormal load the regulating resistance is short-circuited.

1,011,758. SAFETY DEVICE FOR ELEVATORS. John F. Dean, assignor to David R. James and Lee P. Stark, Scranton, Pa. Circuit is completed through a block forced between a pair of intermediately fulcrumed levers, the circuit being completed only when the doors are closed.

1,011,769. INDUCTION-FURNACE. Edward F. Gehrkens, assignor to General Electric Co. A section of the walls of the charge-receiving chamber forms part of the secondary winding.

1,011,771. SUPPORTING-FRAME FOR INCANDESCENT LAMPS WITH METAL FILAMENTS. Ludwig Glaser, assignor to General Electric Co. A group of refractory holders prevent contact between the filaments and other parts of the supporting frame.

1,011,774. CENTRIFUGAL SWITCH. Charles H. Haddrell, assignor to General Electric Co. A rotatable collector ring normally engaging a stationary ring is thrown away from it by centrifugal force when the motor is up to speed.

1,011,777. WIRELESS TELEGRAPHY. Johannes Harden, assignor to General Electric Co. The spark-gap apparatus has a number of mercury electrodes, one of which is surrounded by a silica cup.

1,011,778. REVERSING-SWITCH FOR ELECTRIC MOTORS WITH OPPOSITELY-ROTATING MAGNETS AND ARMATURES. Victor Harhorn, Friedenau, Germany. One brush may be alternatively connected to the slip-ring or the magnet-coil contact, the other being connected to the last mentioned contact or to the slip-ring contact.

1,011,783. INDUCTION MOTOR. Rudolf E. Hellmund, Hinsdale, Ill., assignor to General Electric Co. A number of different windings are connected in, to produce various speeds in either direction.

1,011,784. CIRCUIT-BREAKER. Edward M. Hewlett and Charles H. Hill, assignors to General Electric Co. Has flat conducting strips, insulation being placed between the overlapping portions of the strips.

1,011,785. CIRCUIT-BREAKER. Charles H. Hill, assignor to General Electric Co. A toggle joint cramps the moving contact into position, the operating lever moving independently of the toggle.

1,011,791. INSULATION OF WINDINGS IN ELECTRICAL APPARATUS. Gottlob Honold, assignor to the firm of Robert Bosch, Stuttgart, Germany. Strips of insulating material separate the adjacent layers, the insulation being graded according to potential difference of sections.

1,011,809. ELECTRICAL WATER-HEATER. Louis Katz, assignor of one-half to Robert Davies, San Francisco, Cal. Water flows from faucet past heating coils, the current being turned on and off together with the flow of water.

1,011,824. SELENIUM CELL. Oscar Linder and James B. Replogle, Chicago, Ill. Metallic conductors are separated by minute interstices in which is contained selenium, which material forms the major part of the conductance of the unit.

1,011,825. RESISTANCE UNIT. William J. Lloyd, assignor to General Electric Co. The coil is wound in a cylindrical resistance unit the flexible terminals being led in through insulating bushings.

1,011,841. PORTABLE ELECTRIC ROCK-DRILL. John Albert Pierson, Pigeon Cove, Mass. Rotation of the drill is produced by a motor carried by the tool, an air piston providing for reciprocation in a longitudinal direction.

1,011,842. ELECTRIC SOCKET. Abraham Pikoos, Baltimore, Md. Filed Aug. 26, 1911. Relates to details of lamp-socket construction.

1,011,855. FEEDER VOLTAGE REGULATOR. Benjamin Parks Rucker, Charlotte, N. C., assignor to General Electric Co. Contacts are carried by a shaft, regulation being accomplished by a crang and worm gear which turn the shaft.

1,011,860. ELECTRIC TIRE VULCANIZER. Frederick F. Schwentker, assignor to General Electric Co. The tire is formed and heated by a mold containing heating units.

1,011,879. ELECTRIC HEATER. Arthur M. Wentworth, assignor to General Electric Co. A flat-iron heating unit is inclosed by two mica sheets, the larger of which is cupped, overlapping the other sheet.

1,011,884. IGNITION DEVICE. John F. Cavanagh, assignor of three-fourths to Lindsley & Allen Electric Co., Providence, R. I. The coil and plug are made up as a compact unit.

1,011,890. INCANDESCENT ELECTRIC LAMP. John J. Rooney, New York, N. Y. Has two filaments of different resistances, one or the other being put in use by a turn of the lamp base.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired December 18, 1911:

530,951. ELECTRIC CONDUIT. Thomas T. La Pointe, James H. Flanagan and Charles A. Thomson, New Haven, Conn.

530,956. HAND OPERATING MECHANISM FOR ELECTRIC LOCOMOTIVES. Andrew W. Mitchell, Boston, Mass.

530,975. CIRCUIT-CLOSER FOR BURGLAR-ALARM SYSTEMS. Alfred Stromberg, Chicago, Ill.

531,002. ELECTRIC PROGRAM CLOCK. John L. McCaskey, Waynesborough, Pa.

531,005. ELECTRIC CONVERTER. Frank C. Priestley, San Francisco, Cal.

531,006. DYNAMOMETER. Rolf L. Rolfson, San Francisco, Cal.

531,052. CONTROLLER HANDLE. Henry Mittelsdorf, Orange, N. J.

531,070. CONTROLLING DEVICE FOR ELEVATORS. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y.

531,078. TELEPHONE SPEAKING-TUBE SYSTEM. Thomas C. Wales, Jr., Boston, Mass.

531,109. ELECTRIC BELT. Louis F. Fuller, and Andrew J. Taylor, Norfolk, Va.

531,130. ELECTRICAL SWITCH SETTING AND LOCKING DEVICE. Karl Moderegger, Vienna, Austria-Hungary.

531,143. APPARATUS FOR ELECTRIC HEATING SMELTING AND SEPARATING. Joseph W. Woodfolk and John C. Wharton, Nashville, Tenn.

531,153. ELECTRIC METER. Theodore Bruger, Bockenheim near Frankfort-on-the-Main, Germany.

531,184. TELEPHONE TRANSMITTER. David A. Kusel, St. Louis, Mo.

531,214. ELECTRIC SAFETY APPLIANCE FOR RAILROADS. Edward [illegible], Somerville, Mass.

531,268. [illegible]ND POWER CONTROLLER FOR ELECTRIC CARS. [illegible]ew W. Mitchell, Boston, Mass.

531,284. EL[illegible]CTRIC BLOCK-SIGNALING SYSTEM. Adoniram J. Wilson, Port Chester, N. Y.

531,288. INCANDESCENT-ELECTRIC LAMP SOCKET. Charles H. Baisley, Connelsville, Pa.